# THE

# PRINCIPLES AND PRACTICE

OF

# SURGERY,

EMBRACING

# MINOR AND OPERATIVE SURGERY:

WITH

A BIBLIOGRAPHICAL INDEX OF AMERICAN SURGICAL
WRITERS FROM THE YEAR 1783 TO 1860.

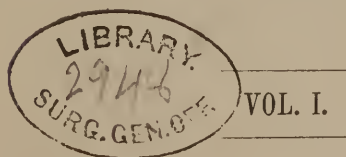## Arranged for the use of Students,

AND

ILLUSTRATED BY 400 WOOD-CUTS, AND NEARLY
1000 ENGRAVINGS ON STEEL.

BY

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IN TWO VOLUMES.

VOL. I.

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# PREFACE.

THE fifth edition of a treatise on "MINOR SURGERY," the second edition of that on "OPERATIVE SURGERY," and the first edition of "THE PRACTICE OF SURGERY," by the author, embracing over ten thousand copies, having been exhausted in 1860, and the demand continuing, arrangements were made by the publishers to issue new editions, and to combine the three treatises in one.

Considerable progress had been made in the prosecution of this plan when the political condition of the country and the author's engagements in the military service, as Surgeon-General of Pennsylvania, temporarily delayed the enterprise. Having now an opportunity of completing the work, it is again offered to the profession, with an acknowledgment of the extended favor with which the author's labors have been received.

The present volumes embrace the substance of the three treatises alluded to. The whole of these has been carefully revised, a considerable portion rewritten, about five hundred pages of new matter added, and the work specially prepared to serve as a text-book or aid to those in attendance on surgical lectures.

By a change of type, paper, and size of page, the form of the volumes has yet been kept within such limits as will render them easily portable, and diminish the cost.

In preparing these for the press, the author has received valuable assistance from his friend and former prosector, Assistant-Surgeon J. J. WOODWARD, U. S. Army. Acknowledgment is also due to DRS. H. LENNOX HODGE and D. HAYES AGNEW, for their aid in revising a portion of the manuscript.

In the hope that the changes made, and additional labor bestowed on this work in correcting and improving its teachings, may add to its usefulness among the younger members of the profession, it is again tendered them by

THE AUTHOR.

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# GENERAL HISTORY OF SURGERY.

## A BRIEF HISTORICAL SKETCH OF SURGERY, ARRANGED CHRONOLOGICALLY.*

THE origin of Surgery being coeval with that of Medicine, dates from the earliest periods of the human race, the reception of injuries naturally requiring that some effort should be made to alleviate them. That surgical operations were performed, at a very remote period, cannot be doubted, the laws of Moses, describing minutely the operation of circumcision, (an operation yet practiced among the Jews, according to ancient usages,) and the embalming of Joseph, indicating the possession of at least such surgical knowledge as was necessary for the opening of bodies.

The earliest individual, directly spoken of in connection with the practice of surgery, and the reputed originator of the science, is the myth named CHIRON, the Centaur, who was supposed to have been born in Thessaly, at some unknown period.

Next, we find mention made of ÆSCULAPIUS, a son of APOLLO, B.C. 1142, who was believed to have been a pupil of CHIRON; and then we have more positive information, in the account by Homer of the events of the Trojan war, in which he describes PODALIRIUS and MACHAON as sons of ÆSCULAPIUS, and as surgeons in this war, B.C. 1184.

PODALIRIUS is reported to have been the first bleeder, having opened a vein in either arm of the daughter of the King of Caria, and received her hand in marriage as his recompense.

The ASCLEPIADES, or reputed descendants of Æsculapius, constitute the only surgeons spoken of during the ensuing 500 years.

After these came PYTHAGORAS, B.C. 608; and, after him, the following may be briefly mentioned in the natural order of time.

DAMOCEDES, a contemporary of Pythagoras, treated King Darius for a sprained ankle; and his queen, Atossa, for cancer of the breast.

After him came Hippocrates, the great father of medicine and surgery, from whom all the rest may be traced.

HIPPOCRATES, B.C. 460, or 357, was among the first of the distinguished surgeons, and practiced many operations, often claimed as modern inventions. He employed the actual cautery of various shapes; used moxa made of rolls of flax; resorted to issues and tents as counter-irritants; and

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* The facts here stated have been chiefly collected from Miller, Richerand, Sharp, Black, Chelius, and the Dictionary of Antiquities, by William Smith, LL.D.

operated for calculi in the kidney by incision, though he did not cut for stone, lithotomy being then confined to a special class of practitioners. He also reduced dislocations and fractures by means yet resorted to ; employed the obstetrical forceps for delivering the fœtus ; frequently employed the trepan in depressed fractures of the skull ; resorted to percussion to prove the presence of fluid in the thorax, and performed the operation for empyema or paracentesis thoracis.    He also wrote many excellent surgical treatises.

After him, DIOCLES CARYSTIUS invented an instrument for extracting darts, and bandaged the head for wounds, etc., by bandages often employed at the present time.

PRAXAGORAS, of Cos, who followed in his footsteps, also proved himself an accomplished surgeon, and some of his operations are yet resorted to. He incised the fauces freely in cases of inflammation ; excised the uvula, and made an artificial anus, or opening into the bowels, in cases of obstruction or ilius.    He also first observed the difference between the arteries and veins, and noted the pulse, though this fact has also been claimed for Aristotle.

ARISTOTLE gave the name to the aorta, and showed that all the blood-vessels centred in the heart.

After him came the anatomist and surgeon, HEROPHILUS, about B.C. 320, though the exact year is unknown.    He was the first surgeon who practiced dissections.

ERASISTRATUS, his contemporary, also dissected and invented many surgical instruments.    This surgeon is reported to have reduced a dislocated humerus for Diodorus Cronus, and by this operation, to have convinced him of the possibility of the existence of *motion*, a fact which he had previously denied.

XENOPHON, his follower, was the first to arrest hemorrhage from the extremities, by a tourniquet, having recommended the encircling of the limb with a cord, in order to check the flow of blood.    Lithotomy, at this period, as during the time of Hippocrates, was avoided by the surgeons, and performed entirely by a special class of individuals who devoted themselves to this one operation.

AMMONIUS, surnamed $\Lambda\iota\theta o\tau o\mu o\varsigma$, devoted much time to the study of calculous affections, employing an instrument to crush calculi, and thus becoming the first surgeon who operated for lithotripsy.*

CASSIUS, B.C. 96, exhibited considerable knowledge of the physiological action of the brain, having described the paralysis of one side of the body as induced by injuries of the opposite portion of the head.

CELSUS, the contemporary of Horace, Virgil, and Ovid, practiced surgery at Rome in the beginning of the Christian era, upwards of 150 years before Galen.    He was the first to describe lithotomy, and his mode of performing it, (central incision,) as well as numerous other operations, is sometimes resorted to by surgeons of the present day.    He described the operation of removing cataract by depression ; mentions the subject of artificial pupil ; gave accurate and judicious rules for the application of the trepan ; was the first to notice that there might be an effusion and compression within the head without fracture ; first recommended the application of ligatures to wounded arteries ; improved the operations of amputation ; applied caustics to the treatment of carbuncle ; described several species of hernia ; and operated for hare-lip, etc., by methods yet in use and often claimed as modern improvements.

* Smith's Dict. Greek and Roman Antiquity—Art. Chirurgie.

ARETÆUS, A.D. 54, reign of Nero, first employed blisters and resorted to cantharides as a vesicating agent. This surgeon condemned the operation for tracheotomy, lest the cartilages should not heal.

RUFUS, the Ephesian, A.D. 98—117, reign of Trajan, wrote on diseases of the kidneys and bladder, and operated by ligating the brachial artery for varicose aneurism at the bend of the arm.

HELIODORUS, the physician to Trajan, about A.D. 120, and contemporary with Juvenal, wrote on injuries of the head.

ANTYLLUS, about A.D. 340, recommended tracheotomy, which had been previously practiced by the Asclepiades in threatened suffocation from diseases of the throat; he practiced arteriotomy in great emergencies, and showed the importance of dividing an artery entirely across, in order to arrest hemorrhage, instead of incising it obliquely. In the treatment of aneurism, he tied the artery above and below the sac, and, opening the latter, allowed the wound to heal by granulations; he also alluded to the operation of cataract by extraction, and reported cures of hydrocele by incision.

CLAUDIUS GALEN, born in the autumn of A.D. 130, wrote upon luxations of the femur backward, a variety not mentioned by Hippocrates; he also described spontaneous luxations of the femur, and trepanned the sternum in empyema.

ÆTIUS, about A.D. 475, scarified the legs in anasarca; employed the cautery; excised hemorrhoidal tumors; employed lithontriptics to dissolve calculi, and wrote on hernia, diseases of the testicle, and castration.

ALEXANDER, of Trallis, a surgeon of the time of Justinian, A.D. 545, wrote on diseases of the eye, and on fractures.

PAULUS ÆGINETA, about A.D. 670, is reported to have bled freely in cases of gravel. He opened abscesses by caustics; defined the points for paracentesis abdominis; sounded the bladder by the finger in the rectum, in cases of stone; cut on the left side of the raphé (lateral operation) in lithotomy, and believed aneurism to be caused by rupture of the coats of the artery. He extirpated the breast by a crucial incision; performed laryngotomy, and is said by some to have been the first to perform tracheotomy, though the Asclepiadeæ had also the credit of the same operation. His incision was made transversely, instead of longitudinally, as practiced at the present day. He performed the operation for strangulated hernia; was the first to treat of fracture of the patella, and originated embryotomy.

CALIPH HAROUN, among the Arabians, had charge of a hospital at Bagdad, about A.D. 790, where no fewer than six thousand students, chiefly Christians, are said to have attended the practice of the house, a number that has not been equaled by any of the more modern schools.

RHAZES, about A.D. 924, first described spina ventosa and spina bifida; he opposed all operations for cancer when the tumor was not entirely free from the surrounding parts, and cauterized poisonous wounds.

HALY ABBAS, A.D. 980, advised the application of caustics to hydrocele, and punctured the linea alba a little below the umbilicus in cases of ascites.

AVICENNA, A.D. 1000, distinguished between closure of the pupil and cataract; preferred depression in cataract to extraction; first resorted to the flexible catheter, and also employed a saw similar to that now named after Hey.

ALBUCASIS, A.D. 1100, is supposed to have been the first who noticed the effect of a clot in the arteries in arresting hemorrhage; he describes an instrument of his own for curing fistula lachrymalis, and also the cataract-needle of his own period. He also reports having operated for hydrocephalus, but with doubtful success; he removed tumors by the ligature, and first described lithotomy as performed on the female; in the male, he prac-

ticed the lateral operation.   He also excised the tonsils and uvula; extracted polypous tumors from the fauces; objected to any attempt at extirpating goitrous tumors; invented the probang; employed sutures in wounds of the intestines; condemned tracheotomy in acute inflammation of the windpipe, and when it had reached the bronchia, and strongly doubted the propriety of operating in cancerous tumors; *declaring that he never cured, or saw cured, a single case.*   He also advised the partial evacuation of large abscesses, as subsequently practiced in England by Abernethy and others, whose names were given to this plan of treatment.

POPE INNOCENT II., A.D. 1139, retarded the progress of surgery, by describing its practice as degrading, and forbidding the clergy to pursue it.

PITARD, A.D. 1271, established the College of Surgeons in Paris.

GILBERTUS ANGLICANUS and JOHN OF GADDESDEN, two surgeons of distinction, practiced in England A.D. 1300, 1320.

GUY DE CHAULIAC, A.D. 1360, first described the Cæsarean operation.

JOHN OF ARDEN, A.D. 1370, operated very successfully for fistula; improved the trepan, and added the centre pin.

VALESCO DE TARANTA, A.D. 1410, practiced at Montpellier, and first proposed the application of arsenic to the cure of cancer.

GERMAIN COLOT, surgeon of Louis XI., A.D. 1460, restored the operation of lithotomy to the medical profession by an act of the law.

A.D. 1440–1450 was distinguished by the discovery of printing, which had a marked influence on the progress of medicine and surgery.

A.D. 1492, Discovery of America.   It may, perhaps, specially interest the American student to know that syphilis was described by Albucasis, Avicenna, Valesco, and John of Gaddesden, nearly 100 years before this period,* and that its origin in connection with the expedition of Columbus is by no means established.

VESALIUS, in A.D. 1550, taught anatomy; and EUSTACHIUS, in A.D. 1560, did the same.

AMBROSE PARÉ, in France, A.D. 1560, created a new period in surgery, both by his practice and writings.   He wrote on gunshot wounds, firearms being much used at this period; he employed ligatures more than the actual cautery, and first resorted to the twisted suture in hare-lip, copying the mode in which the ladies and tailors carried the thread and needle in their cuffs.

TALIACOTIUS, an Italian, in A.D. 1597, revived and systematized the class of plastic or "Taliacotian" operations which had previously been practiced in a very irregular manner by empirics.

FABRICIUS AB AQUAPENDENTE, A.D. 1610, the preceptor of Harvey, introduced the modern trephine, or the instrument now generally employed both in England and America; he also invented the curved canula, which is resorted to after the operation of tracheotomy.

WISEMAN, of England, A.D. 1676, the surgeon to Charles II., advocated immediate amputation in military surgery, and especially before fever set in.

JAMES YOUNG, of Plymouth, A.D. 1679, first proposed the flap amputation, since claimed by Verduin and Sabaurin, and first recommended that compression should be limited to the artery, in amputation.

FABRICIUS HILDANUS, A.D. 1653, of Germany, and SCULTETUS, each wrote an Armamentarium Chirurgicum, which includes a large number of surgical instruments illustrative of the practice of their own and preceding periods.

DIONIS, BELLOSTE, SAVIARD, and MOREL, in France, all practiced surgery during the seventeenth century.

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* See Lectures of Sir A. Cooper, by Lee.

HEISTER, A.D. 1710, was highly distinguished as a surgeon, and wrote a voluminous and excellent work on the Practice of Surgery, to which modern surgeons are largely indebted.

DESAULT, of France, A.D. 1730, first taught surgical anatomy. This distinguished surgeon made many improvements in surgery ; among others, he changed the curved amputating knife to the present straight one ; urged the cure of artificial anus, by removal of the septum between the ends of the bowel, and also first proposed ligating the distal side of the tumor in aneurism.

PETIT, A.D. 1740, did much to advance French surgery ; he invented the screw tourniquet, and was the first who operated for fistula lachrymalis by transfixing the sac.

LE DRAN, SABATIER, GARRANGEOT, LOUIS, CHOPART, and MOREAU were also eminent French surgeons during the eighteenth century.

# HISTORY

OF

# SURGERY IN THE UNITED STATES.

HISTORICAL RECORD OF SOME OF THE PRINCIPAL FACTS CON-
NECTED WITH THE ORIGIN AND PROGRESS OF MEDICINE AND
SURGERY IN THE UNITED STATES, ARRANGED CHRONOLOGI-
CALLY.*

THE history of Surgery in the United States is so closely identified with
that of Medicine as to render it useless to attempt to separate them ; nor is
it desirable to do so, the existence of surgery, as a distinct branch, being
only the result of violence, both having naturally a common trunk.    In
practice, in the United States, any effort to accomplish this separation is
also futile, the most distinguished surgeons having been and yet being, in
many instances, the most accomplished physicians of their respective
localities.

As the United States of America in their earliest periods were colonized
chiefly from Great Britain, the medical wants of the settlers were necessarily
supplied by practitioners who emigrated with them from Europe.    A large
number of the first emigrants being also those who left their homes on
account of religious persecutions, we find that many of our early physi-
cians united the clerical function with the practice of medicine, or were
colonial officers, who, while regulating the body politic, also undertook the
treatment of the physical derangements of the hardy colonists.

The following facts, though mainly of local interest, and specially con-
nected with the origin of the profession in particular towns, are yet deemed
worthy of general notice, as showing the condition of the medical profession
in this country during a period of over two hundred years.

In 1620 the country now known United States of America was a wilder-

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* For the facts and dates furnished in this synopsis, I have drawn upon various
authorities, but especially upon the following writers:—
    American Medical Biography, or Memoirs of Eminent Physicians who have flour-
ished in the United States, by James Thacher, M.D., Boston, 1828.
    Annual Address, ("On American Medicine before the Revolution,") delivered before
the Medical Society of the State of New York, Feb , 1842, by John B. Beck, M.D.,
President of the Society.
    A Review of the Improvements of Medicine in the Eighteenth Century, by David
Ramsay, M.D , Charleston, 1800.
    American Medical Biography, or Memoirs of Eminent Physicians, etc. etc., by
Stephen Williams, M.D., Greenfield, Mass., 1845.
    History of Kentucky Surgery, by S. D. Gross, M.D., Louisville, Ky., 1853.

ness. In 1850 it had more than 40,000 practitioners of medicine, and a population of 25,000,000 souls. As this population in many of the States is very widely scattered, the practice of medicine in some sections of the country frequently occupies so much time as to leave the practitioner comparatively little for such labor as would tend to the formation of a national medical literature. Notwithstanding this, an examination of the medical and scientific journals will clearly show that, though often overtaxed corporeally, American physicians have made a creditable effort to record and publish the results of their individual observations; so that those who in our large cities were more favorably situated for mental labor have been able to collect and exhibit such an amount of facts as has given to the American profession the credit of having originated some most useful plans of treatment.

In surgery especially do we notice the suggestion of operations of an original character, which, while benefiting the community at large, have also tended to advance the interests of the profession, by leading to the development of other operations of an analogous character. As examples of these, we may cite the operations of ovariotomy, by McDowell, of Kentucky; of resection of the lower jaw, by Deaderick, of Tennessee; removal of anchylosis of the knee and hip joint, by Barton, of Philadelphia; extirpation of the parotid gland, by Warren, McClellan, etc., all of which have been operations of sufficient brilliancy and utility to have invited the attention of foreign surgeons.

Although the engagements of the American practitioner have often been constant and onerous, the profession appears to have enjoyed its full share of health and long life, as compared with that obtained by those engaged in other pursuits From an examination of some of the statistics furnished by Dr. Stephen Williams, and published in his *Medical Biography*, it appears that the practice of medicine in the United States, though very laborious, is not unfavorable to a long life. Out of 1060 practitioners who had been Fellows of the Massachusetts Medical Society, 1 died at the age of 100 years, 34 were upwards of 80, and 119 were between 50 and 80.

Thacher, in his *Biography*, also reports 3 who died between 90 and 100 years of age, 23 between 80 and 90, 7 between 85 and 90, 27 between 70 and 80, and 29 between 60 and 70 years of age—so that out of 148 whose names he has collected, almost one-half have lived over the period of threescore years and ten, or that usually allotted to man. Nor has this advanced age been always accompanied by mental debility; on the contrary, many of the American physicians have possessed active minds to the last. Thus, Dr. John Huss, of Durham, New Hampshire, who died at the age of 108, was very vigorous; and Dr. Holyoke, of Massachusetts, retained his intellectual vigor until his one hundredth year, having in 1821, when 92 years old, operated for paracentesis abdominis.*

The first record of the presence of a physician, as a resident of this country, is found in the settlement of Virginia, where, in 1608, one year after the settlement of the colony, Dr. WALTER RUSSEL arrived from England.

In 1620, Dr. SAMUEL FULLER, a deacon in the church of the Rev. John Robertson, arrived at Plymouth in the first ship with the Puritans.

In 1635, Dr. THOMAS THACHER came over from England, and subsequently published the first American medical work.

In 1637, Dr. JOHN FISK arrived and settled at Salem as a clergyman and physician.

In 1638, Harvard University, of Massachusetts, was founded. Many of its early collegiate graduates, after obtaining medical degrees in Europe,

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* Williams's Biography.

returned to practice their profession in their native country, bringing with them the views and practice of their European teachers, and thus establishing the practice of medicine in this country on the basis of that taught during their pupilage in the European schools.

In 1642, SAMUEL BELLINGHAM and HENRY SALTONSTALL graduated in the arts at Harvard University, but took their degree of M.D. in Europe.

In 1644, we notice that Dr. THOMAS OLIVER is spoken of, in the Journal of Governor Winthrop, as "a skillful surgeon."

In 1649, a law was passed in Massachusetts "regulating the practice of chirurgeons, midwives, and physicians."

In 1650, Dr. JOHN GLOVER graduated at Harvard, and obtained a medical degree at Leyden. Dr. HOWARD did the same.

In 1651, Dr. ISAAC CHAUNCEY graduated at Aberdeen, Scotland, and then settled in Massachusetts.

In 1662, Dr. JOHN WINTHROP was made Governor of Connecticut. He was one of the founders of the Royal Society of England, being in London at that time as an agent for the colony.

In 1667, Dr. THOMAS THACHER, of Massachusetts, published a medical tract, entitled "A Brief Guide in the Small-pox and Measles," being the first medical publication in the country.

In 1669, Dr. HENRY TAYLOR, of Boston, practiced surgery in that town, and "had his rate remitted for attending the poor."

In 1673, Dr. SAMUEL FULLER was appointed Surgeon-General to the Forces.

In 1674, Dr. EDMUND DAVIE, of Harvard, obtained the degree of M.D. at Padua.

In 1682, Dr. THOMAS WYNN and brother, Welsh physicians, located themselves in Philadelphia, and were the earliest practitioners in this city.

In 1691, William and Mary College, in Virginia, was founded for the education of young men, but without any medical department.

In 1700, Dr. JOHN NICOLL, a graduate of Edinburgh, located in New York City.

In the same year, Dr. HAMILTON, a Scotch physician, settled in Maryland.

At the same period, Dr. JOHN MITCHELL, of England, settled in Virginia.

In 1700, Yale College, Connecticut, was founded.

In 1704, the first American newspaper (the *Boston News Letter*) was published in the United States, and doubtless had its influence on the profession in disseminating general information. The first printed newspaper (the *English Mercurie*) was published in England in the reign of Queen Elizabeth, July 23, 1588, and a copy of it is now in the library of the British Museum. The *Boston News Letter*, which, as just stated, was the first in the United States, was published one hundred and sixteen years subsequent to this. The second journal in the United States was the *Boston Gazette*, and the third the *Philadelphia Weekly Mercury;* the latter two being published in 1719. The first number of the *Philadelphia Mercury* may be seen in the Loganian portion of the Philadelphia Library, Philadelphia.

In 1705, Dr. JOHN CLAYTON, of England, settled in Virginia.

In 1707, Dr. GRŒME came over with the governor, and settled in Philadelphia.

In 1712, Dr. GUSTAVUS BROWN, of Scotland, located himself at Port Tobacco, Maryland, and was the most distinguished practitioner of that and the adjoining State.

In 1716, Dr. WILLIAM DOUGLASS, of Scotland, emigrated to New England.

In 1718, Dr. COLDEN, of Scotland, settled in New York.

In 1720 or 1730, Dr. LLOYD ZACHARY, one of the founders of the Pennsylvania Hospital, commenced practice in Philadelphia.

In 1720, Dr. COLDEN wrote an account of the climate and diseases of New York City, recommending it as especially favorable to consumptive patients.

In 1721, Dr. BENJAMIN COLMAN, a clergyman of Boston, published a pamphlet on inoculation, defending the practice as introduced by Dr. Boylston, of that place.

In 1721, Dr. COTTON MATHER introduced inoculation into Boston.    Experiments were also made by Dr. Boylston in June, 1721, upon his own family.    This practice created such inflammatory conduct on the part of the other physicians and the populace as to endanger their lives.    The first case, Lady Mary Wortley Montague, was inoculated in England in April, 1720, only one year previously.

In 1725, Dr. BOYLSTON was handsomely received at court in London, and was the first American who was elected a fellow of the Royal Society.    The ensuing year he published in England, at the request of the Royal Society, "An Historical Account of the Small-pox, as inoculated in New England."

In 1730, Dr. NATH. WILLIAMS wrote on the practice in small-pox.

In 1732, Dr. WALTON published an essay on fever.

In the same year, Dr. THOMAS HOWARD published a treatise on pharmacy.

In 1734, Dr. WILLIAM BULL, of North Carolina, after studying under Böerhaave, graduated at Leyden, and wrote on lead colic.

In 1736, Dr. WILLIAM DOUGLASS published "The History of a New Epidemical Eruptive Fever," which prevailed in New England in 1735–36.

In 1736, Dr. DOUGLASS employed calomel in the treatment of inflammation.    This practice has been claimed for Dr. Robert Hamilton, of England, but his attention, it is well known, was not called to it until 1764.

In the same year, Dr. JOHN TENENT, of Virginia, published an account of the Polygala Senega.

In 1737, 1741, 1742, Dr. JOHN MITCHELL, of Virginia, treated yellow fever by copious bleedings.

In 1740, Dr. MAGRAW, of Scotland, settled in New York City.

In the same year, Dr. THOMAS CADWALADER, of Philadelphia, published an "Essay on the Iliac Passion," recommending mild purges and opiates, instead of the violent treatment previously pursued.

In 1741, Dr. COLDEN published an account of the fever which prevailed in New York; also, a paper on cancer.

In 1743, Dr. JOHN MITCHELL, of Virginia, published letters on the yellow fever of 1741, in Virginia; also, on "The Causes of Different Colors of People in Different Climates."

In the same year, Dr. CLAYTON published the "Flora Virginiana," which was deemed so valuable that it was republished by GRONOVIUS, at Leyden, in 1762.

In 1746, Dr. COLDEN, Lieutenant-Governor of New York, gave Madeira wine freely in yellow fever, with much success.

In 1746, Princeton College, New Jersey, was founded.

In 1748, Dr. JOHN LINING, of Charleston, published a description of the American yellow fever.

In 1749, Dr. JOHN MOULTRIE, of Charleston, graduated at Edinburgh, being the first native Carolinian who obtained this honor.

In 1750, Drs. JOHN BARD and PETER MIDDLETON injected and dissected

the body of a criminal for the instruction of the students, being the first dissection recorded in the United States.

In 1752, the Pennsylvania Hospital was established in Philadelphia, being the first general hospital in this country. Its surgical wards, under the charge of Drs. Physick, Hartshorne, Parrish, Barton, and others, have always largely contributed to the advancement of surgical practice.

In the same year, patients were received into its wards.

In 1753, Dr. JAMES LLOYD, after enjoying the instruction of Warner, Sharpe, Smellie, and Hunter, of London, settled in Boston, and was the first systematic practitioner of midwifery, etc. in that section.

In 1754, Dr. LIONEL CHALMERS, of Charleston, wrote a paper on tetanus, then very prevalent in that city, recommending bleeding, the warm bath, and opiates.

In the same year, Dr. THOMAS BOND, of Philadelphia, wrote an account of a worm found in the liver.

At the same period, Dr. Bond was actively engaged as a medical officer in the Pennsylvania Hospital.

In 1755, Drs. ANDREW ROBINSON and JAMES CRAIK came over as surgeons to Braddock's army, and settled in Virginia.

In 1756, Dr. WILLIAM SHIPPEN, Jr., of Philadelphia, returned from Europe, and commenced practice in his native city. In 1765, he was elected Professor of Surgery in Philadelphia, and was the first Professor of Surgery in the United States.

In 1759, inoculation was generally adopted in Philadelphia.

In the same year, Dr. JOHN BARD, of New York, published several papers on yellow fever, and on the pleurisy, which prevailed on Long Island in 1749.

In 1759, Dr. BOND wrote on the use of bark in scrofula.

In 1760, the General Assembly of the Province of New York ordained that no person should practice in the City of New York as a physician or surgeon before he had been examined and approved by one of his majesty's council. During the same year, Dr. WILLIAM DOUGLASS published a summary of the progress and planting of the British settlements in America, which contained a notice of the state of the medical profession.

In 1763, Dr. JOHN MORGAN, of Philadelphia, graduated at Edinburgh, and maintained in his inaugural essay that *pus was a secretion.* The credit of this doctrine has usually been assigned to Mr. John Hunter, but there is no doubt of his having been anticipated by Dr. Morgan.*

In 1765, the Medical Department of the University of Pennsylvania was organized and located in Philadelphia. No school of medicine had existed in the United States prior to this period, though Dr. Wm. Shippen, of Philadelphia, lectured in Philadelphia, on anatomy, during the three preceding years. Dr. Shippen was the first Professor of Surgery in this school, which in 1768 furnished ten graduates in medicine. Since then it has contributed largely to the medical education of the whole country; very many of the

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* Dr. James Curry, Lecturer at Guy's Hospital, in referring to the priority of this opinion of Dr. Morgan, says: "I cannot avoid giving the merit to Dr. Morgan, who discussed the question with great ingenuity in his Inaugural Dissertation on taking his degree at Edinburgh, in 1763, and I can find no proof that Dr. Hunter taught, or even adopted such an opinion, until a considerably later period."

See also Cullen's "First Lines," by Charles Caldwell, M.D., vol. i. p. 225, note by Dr. Caldwell.

Also, Lond. Med. and Phys. Journ. for 1817, and New England Journ. of Med. and Surgery. vol. vi. p. 401. (Quoted from Dr. Beck.)

professors in the numerous schools now scattered over the United States looking back to this school as their Alma Mater.

In the same year, Dr. MORGAN delivered an address on "The Institution of Medical Schools in America," at the first commencement of the University.

In 1768, Columbia College, New York, (then King's,) was founded.

In the same year, Dr. CHALMERS, of Charleston, published an "Essay on Fevers," and in 1776, "Meteorological Observations taken at Charleston, from 1750 to 1760."

In 1769, Dr. KEARSLEY, of Philadelphia, wrote a paper on angina maligna.

In the same year, Dr. PETER MIDDLETON, of New York, delivered an address "On the State of Medicine," at the opening of King's College, New York. Dr. John Jones was the first Professor of Surgery in this college.

In 1769, Dr. SAMUEL BARD suggested the establishment of the New York Hospital. The building was erected in 1773, but destroyed shortly afterward by fire, when nearly completed, and did not receive patients until 1791. It is now, 1862, possessed of very extensive surgical wards, and contributes its full quota to the progress of surgical science.

In 1770, Dr. BAYLEY, a surgeon of New York, described* the false membrane in croup as the result of inflammation, and treated it by bleeding, tartar emetic, and calomel. The credit of this practice was incorrectly claimed for Dr. CHEYNE more than twenty years subsequent to Dr. Bayley's publication.

In 1771, Dr. SAMUEL KISSAM, of New York, published an inaugural essay "On the Anthelmintic Virtues of Cowhage."

In 1775, Dr. SAMUEL ADAMS, of Massachusetts, attended the soldiers wounded at Lexington, and Dr. MILES WENTWORTH, of Boston, was surgeon to the American prisoners wounded at the battle of Bunker Hill.

In the same year, Dr. Jos. WARREN, an eminent surgeon of Boston, (then a general,) fell at the battle of Bunker (Breed's) Hill.

In 1775, Dr. JAMES THACHER, of Massachusetts, commenced his duties as assistant-surgeon among the wounded at Bunker Hill.

In 1776, Dr. JOHN MORGAN, of Philadelphia, received from Congress the appointment of Director-General of the U. S. hospitals.

In 1776, Dr. JOHN JONES, Professor of Surgery in New York, published a volume on wounds and fractures, which was of much service to the army surgeons during the Revolution.

In the same year, Dr. BENJAMIN RUSH, of Philadelphia, was a member of Congress, and one of the signers of the Declaration of Independence.

In 1777, Dr. CROSBY, a graduate of the University of Pennsylvania, was surgeon to General Washington's life guard.

In the same year, Dr. MERCER (then General) fell at the battle of Princeton.

In 1780, Dr. JOHN WARREN, surgeon of a military hospital in Boston, commenced a course of anatomical lectures, which are thought to have been the first given in that city.

In 1780, Dr. JAS. THACHER, of Massachusetts, was on duty as an army surgeon at West Point, and witnessed the execution of the unfortunate Major André. He was also present at the surrender of Cornwallis in the same year.

In 1781, Dr. JOHN WARREN amputated at the shoulder-joint, being the first operation of the kind recorded in the United States. This amputation

* New York Medical Repository, vol. xiv. p. 136.

was also successfully performed by Dr. BAYLEY, of New York, assisted by
Dr. WRIGHT, in 1782.   His operation has been often referred to* as the first
amputation of the kind performed in this country, but that of Dr. Warren
preceded it.

In 1786, the Philadelphia Dispensary was established, being the first
institution of the kind in the United States.

In 1787, the Philadelphia College of Physicians was established.

In 1792, Dr. PHYSICK, afterward the most distinguished surgeon in this
country, graduated at Edinburgh.

In 1794, Dr. PHYSICK was elected one of the surgeons of the Pennsylva-
nia Hospital.

In 1795, he invented the stylet for cutting strictures of the urethra, and
first operated for lithotomy in 1797.   In this operation he cut the internal
pudic artery, and the difficulty of arresting the hemorrhage led, in 1802, to
the invention of his needle and forceps for the ligature of this and other
deep-seated vessels.   Previous to this time, surgeons had deemed the ligature
of the internal pudic a matter that was almost impossible.

In 1796, Dr. WRIGHT POST, of New York, tied the femoral artery suc-
cessfully for aneurism, the patient living about thirty years subsequently.

In 1798, Dr. JOHN WARREN, of Boston, extirpated the parotid gland,
being the first operation of the kind known.

In the same year, Dr. NATHAN SMITH, who was celebrated for his surgical
abilities, founded Dartmouth College, and was the sole professor for twelve
years, lecturing on all the different branches; thus exhibiting a degree of
industry and energy that has never been surpassed, all his courses of lectures
being spoken of as "complete."

In 1800, Dr. WATERHOUSE, of Cambridge University, was the first who
vaccinated in the United States; being one year after the discovery of
Jenner.

In August, 1801, Dr. Jos. GLOVER, of South Carolina, who had gradu-
ated the previous year at the University of Pennsylvania, excised a large
portion of the spleen, which had protruded through a wound, and the patient
rapidly recovered.

In 1802, Dr. JOHN C. WARREN, of Boston, commenced practice as a
surgeon, and, after fifty-two years of active life, continued to take an interest
in professional duties.

The same year, Dr. PHYSICK operated for the cure of false joint, by intro-
ducing a seton between the ends of the bones.   He ligated the brachial
artery for varicose aneurism at the bend of the arm in 1803.

In the same year, Dr. MASON F. COGSWELL, of Hartford, Connecticut,
ligated the carotid artery in removing a scirrhous tumor from the neck; the
patient, however, died on the nineteenth day.   This is believed to be the first
operation on this artery ever practiced in the United States, and among the
first three ever performed; Heberstreit, Abernethy, Cogswell, and Fleming
being the first four surgeons who attempted the operation.   The operation
of Sir Astley Cooper was performed in 1805, for aneurism, and his patient
also died on the nineteenth day.

In this year, Dr. JOHN C. WARREN ligated the femoral artery.   Previous
to 1800, capital operations seem to have been rare or were unrecorded, though
doubtless the Revolution afforded many occasions for their performance by
the surgeons of that period.

In 1805, Dr. McCLELLAN, of Franklin County, Pennsylvania, extirpated
the parotid gland.

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* Thacher's Biography of Bayley.

In 1806, Dr. WALTER BRASHEARS, of Kentucky, amputated at the hip-joint successfully. This was the first operation of the kind known to have been performed in the United States.

In 1807, Dr. SAMUEL WHITE, of Hudson, New York, removed a tea-spoon from the intestines, by incising the abdomen and opening the bowel; the patient recovered. In 1808, he also successfully extirpated the parotid gland.

In 1809, Dr. PHYSICK operated for artificial anus, by inducing adhesion between the two sides of the bowel and then dividing the septum.

In December, 1809, Dr. McDOWELL, of Kentucky, removed a large ovarian tumor through the abdominal parietes of three different patients—all successfully. This operation was the first of the kind ever performed in any quarter of the world, and was repeated by Dr. McDowell thirteen times.*

In 1810, Dr. DORSEY, of Philadelphia, tied the external iliac, being the first time this operation was performed in America.

In the same year, Dr. DEADERICK, of Tennessee, amputated half of the lower jaw, being the first resection of so large a portion of this bone ever performed.

In 1811, Dr. MOSES SWEAT, of Maine, also extirpated a parotid gland.

In 1812, Dr. STEVENS, of New York, ligated the external iliac artery successfully.

In the same year, Dr. WILLIAM GIBSON, then of Baltimore, ligated the primitive iliac in the case of a wound in the groin.

In 1812, Dr. EPHRAIM McDOWELL, of Kentucky, successfully lithotomized James K. Polk, who was then a poor boy, though subsequently President of the United States.†

On January 7th, 1813, Dr. WRIGHT POST, of New York, tied the common carotid artery successfully.

In 1813, Dr. CHARLES McCREARY, of Kentucky, resected and excised the entire clavicle successfully, the patient living thirty-five years after the operation, and having the use of the limb. This was the first operation of the kind performed in the United States.‡ Dr. Mott's operation was performed fourteen years subsequently, without his being aware of Dr. McCreary's operation.

In 1814, Dr. BOWEN, of Providence, amputated at the shoulder-joint.

In 1815, Dr. VALENTINE MOTT, of New York, tied the innominata, his patient living twenty-six days subsequently.

In 1815, Dr. HUBBARD, of Connecticut, ligated the axillary artery successfully.

In the same year, Dr. WHITRIDGE, of Sackett's Harbor, ligated the external iliac artery. At the same period, Dr. WHITRIDGE also amputated successfully at the shoulder-joint.

In 1816, Dr HUNT, of Washington, excised the head of the humerus, and Dr. PHYSICK published an account of the advantages of animal ligatures in ligating arteries.

In 1817, Dr. WRIGHT POST, of New York, tied the subclavian artery externally to the scaleni muscles, being the first successful operation performed on this vessel in the United States.

In 1818, Dr. GLOVER, of Charleston, performed the operation of tapping the head in a case of hydrocephalus. This operation is believed to have been the only case published, either by English or American surgeons, since 1778.

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* Gross, History of Kentucky Surgery.

† Ibid , Report on Kentucky Surgery.

‡ Ibid., Report on Kentucky Surgery.

The same year, Dr. BROWN, of Maryland, excised the entire head of the humerus.*

In 1820, Dr. PHYSICK invented his instrument for excision of the tonsils. This instrument was so well adapted to the operation that it has retained its position before the profession, notwithstanding the introduction of numerous others.

In the same year, Dr. JOHN C. WARREN, of Boston, operated successfully for staphyloraphy, being the first time it was performed in America.

In 1821, Dr. MOTT, of New York, amputated half the lower jaw after ligating the carotid; being the second case in the United States, but the first published.

In the same year, Dr. ANTHONY, of Georgia, resected the fifth and sixth ribs nearly entire.

In 1822, Dr. NEWMAN, of Pennsylvania, amputated the tongue successfully for lingua vitula.

In 1823, Dr. A. H. STEVENS, of New York, resected nearly the entire upper jaw successfully; and in the same year, Dr. GEORGE McCLELLAN, of Philadelphia, removed all the lower jaw from its angles forward, for the relief of an osteo-sarcomatous tumor. The specimen was in the museum of the Pennsylvania College of Philadelphia.

In 1824, Dr. DAVID L. ROGERS, of New York, also removed nearly the entire upper jaw.

In 1825, Dr. DUDLEY, of Kentucky, tied the subclavian artery successfully.

In 1825, Dr. GEO. McCLELLAN, of Philadelphia, ligated the carotid artery in three children, five, nine, and sixteen years old.

In the same year, he extirpated the parotid gland, and repeated the operation on another patient in 1829.

In 1825, Dr. BUTT, of Virginia, resected and removed the entire *radius* successfully.

In the same year, Dr. BRIGHT, of Kentucky, is reported to have successfully removed nearly the entire rectum.

In 1826, Dr. RHEA BARTON, of Philadelphia, resected the femur near the hip-joint for anchylosis, and established a false joint, upon which the patient walked.

In 1827, Dr. MOTT, of New York, ligated the primitive iliac artery successfully, and in another case removed the entire clavicle.

In the same year, Dr. S. POMEROY WHITE, of New York, (formerly of Hudson,) tied the internal iliac artery.

In this year, Dr. AMASA TROWBRIDGE, of New York State, cured a case of spina bifida, by ligating the base of the tumor with a wire ligature.

In June, 1828, Dr. MOTT, of New York, extirpated the entire clavicle on account of a tumor.

In 1828, Dr. JOHN C. WARREN, of Boston, removed half of the lower jaw.

In 1829, Dr. J. KEARNY RODGERS, of New York, successfully straightened an anchylosed hip, by resection of the femur.

In the same year, Dr. MOTT, of New York, relieved an anchylosed jaw by dilatation and incision of the soft parts.

At the same period, Dr. THOMAS HARRIS amputated half the tongue successfully, and

Dr. GILLESPIE, of Virginia, successfully resected the astragalus in a compound dislocation.

In 1831, Dr. DEPEYRE, of New York, operated for lithotripsy, being the first surgeon who performed the operation in the United States.*

In 1831, Dr. BARTON removed nearly half of the lower jaw, but left the base of the maxilla as a rim of bone to preserve the outline of the face.

In 1833, Dr. MOTT ligated the right subclavian artery *within* the scaleni muscles.

In the same year, Dr. HALL, of Baltimore, ligated the innominata, but without success.

In 1834, Dr. THOMAS HARRIS reseeted the elbow-joint.

In 1835, Dr. BARTON reseeted the femur above the knee in a case of anchylosis, where the leg was bent at a right angle to the thigh, and straightened the limb so that the patient could walk.

In 1837, Dr. J. MASON WARREN, of Boston, successfully performed the Taliacotian operation for the restoration of a nose, being the first surgeon who performed this operation in the United States.

In the same year, Dr. MUSSEY removed the entire scapula and clavicle, in a case in which he had amputated the arm at the shoulder-joint six years previously.

In 1838, Dr. GEO. McCLELLAN removed the scapula and clavicle, as well as the entire limb of the same side.

In 1841, Dr. GURDON BUCK, Jr., of New York, resected the elbow-joint.

In 1842, Dr. SCHMIDT, of New York, relieved anchylosis of the lower jaw by a subcutaneous division of the masseter muscle.

In the same year, Dr. JOHN C. WARREN removed the upper jaw bone.

In 1844, Dr. JNO. WATSON, of New York, operated successfully for œsophagotomy.

In 1845, Dr. BUCK, of New York, reseeted the knee-joint, by excising a wedge-shaped portion of the patella, condyles, and articulating surfaces of the tibia.

In the same year, Dr. J. KEARNY RODGERS, of New York, tied the left subclavian artery *within* the scaleni muscles.

In 1846, Dr. J. KEARNY RODGERS ligated the internal iliac artery successfully.

In the same year, the inhalation of ether, for the purpose of destroying sensibility in surgical operations, was discovered by Dr. MORTON, of Boston, and brought into use by Dr. JOHN C. WARREN, of the same city.

In 1847, Dr. SWEAT, of Maine, amputated at the hip-joint successfully.

In 1850, Dr. WILLIAM E. HORNER reseeted the entire half of the upper jaw, without making any external incision in the cheek.

In the same year, Dr. PAUL F. EVE, of Georgia, extirpated the entire womb successfully.

In the same year, Dr. GROSS, then of Louisville, resected nearly the entire scapula.

In 1851, Dr. Gilbert, of Philadelphia, suggested the use of adhesive plaster, spread on strips of linen, as a means of maintaining counter-extension in fractures of the femur; a valuable improvement on the former methods of treatment.

In 1851, Dr. CARNOCHAN, of New York, resected (for necrosis) the entire lower jaw successfully, disarticulating it at both condyles.

In the same year, Dr. PEASLEE, of New York, performed ovariotomy, and removed *both* ovaries successfully, by the large peritoneal section.

In the same year, Dr. GEO. HAYWARD, of Boston, published an account

of several cases of vesico-vaginal fistula successfully treated by his own method of operating.

In 1852, Dr. J. MARION SIMS, of Alabama, (now of New York,) reported several cases of vesico-vaginal fistula cured by means of ingenious instruments, of his own inventing, closing the wound by the "clamp suture."

In 1854, Dr. Robert, of Charleston, removed the astragalus.

In 1854, Dr. Carnochan, of New York, removed the entire ulna.

In 1854, Dr. Steven, of Ontario County, N. Y., disarticulated the femur at the hip-joint, and excised its head successfully.

In 1854, Dr. Geddings, of Charleston, extirpated the entire uterus successfully.

In 1855, Dr. Markoe, of New York, reduced a dislocation of the femur at the hip-joint, of two years' standing, by manipulation alone, after the plan of W. W. Reid, M.D.

In 1856, Dr. Blackman, of Cincinnati, removed the entire lower jaw for osteo-sarcoma.

In 1856, Dr. Owen, of Charleston, S. C., reported the performance of the Cæsarean section three times in the same patient.

In 1856, Dr. H. G. Davis, of New York, suggested the treatment of hip disease by a splint, keeping up continued elastic extension and counter-extension, yet permitting motion of the joint while the patient walked about, thus establishing excellent cures in a much shorter time than under former methods of treatment.

In 1856, Dr. Bozeman, of Alabama, treated vesico-vaginal fistula by his button-suture, in seven successful operations.

In 1857, Dr. Toland, of San Francisco, reported the reproduction of bones and joints after removal in cases of whitlow.

In 1859, Dr. E. S. Cooper, of San Francisco, ligated the innominata for the cure of aneurism of right carotid and subclavian arteries.

In 1859, Dr. Warren Stone, of New Orleans, ligated the common iliac artery for aneurism, employing a silver ligature. Death ensued on the twenty-sixth day, from exhaustion by dysentery.

In 1859, Dr. Nott, of Mobile, extirpated a testicle containing hair.

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# BIBLIOGRAPHICAL INDEX

OF

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The Minor Surgery of Bourgery.    Translated from the French, by William C. Roberts, M.D., and J. B. Kissam, M.D.    8vo. New York, 1834.

A Compendium of Operative Surgery, intended for the Use of Students, and containing Descriptions of all Surgical Operations.    Illustrated by engravings, by Thos. L. Ogier, M.D., and Thos. M. Logan, M.D.    No. 1, 4to. and four colored lithographic plates.    Charleston, 1834.

Medical and Physical Researches, or Original Memoirs in Medicine, Surgery, Physiology, etc. etc., by R. Harlan, M.D.    8vo. Philadelphia, 1835.

A Manual of the Diseases of the Eye, or a Treatise on Ophthalmology, by S. Littell, Jr., M.D.    12mo. Philadelphia, 1836–46.

Practical Observations on Strangulated Hernia and some of the Diseases of the Urinary Organs, by Joseph Parrish, M.D.    8vo. Philadelphia, 1836.

Surgery Illustrated, compiled from the Works of Cutler, Hind, Velpeau, and Blazius; 52 plates, by A. Sidney Doane, M.D.    8vo. New York, 1836.

A Treatise on the Malformations, Injuries, and Diseases of the Rectum and Anus.    Illustrated with plates, by George M. Bushe, M.D.    8vo. New York, 1837.

The final report of a Committee of the Philadelphia Medical Society, on the construction of instruments and their mode of action in the Radical Cure of Hernia, etc., by Heber Chase, M.D.    8vo. Philadelphia, 1837.

Surgical Observations on Tumors, with Cases and Operations, by John C. Warren, M.D.    8vo. Boston, 1837, and London, 1839.    (Illustrated.)

Essay on Cataract, by Theodore Maunnoir, M.D.    Geneva.    Translated From the French, by Henry J. Bowditch, M.D.    Boston, 8vo. 1838.

On the Application of the Ligature to Arteries or their Trunks, at a distance from the wounded part and nearer the heart, a Contribution to Traumatic Hemorrhages, by Charles J. Beck, M.D.    Freiburg.    Translated from the German, by Edward G. Davis, M.D.    Philadelphia, 1838.

Practical Surgery, by Robert Liston, M.D., with Additional Notes and Illustrations, by George W. Norris, M.D.    8vo. Philadelphia, 1838–42.

Boylston Prize Dissertations, (On Cancer of the Mammæ,) by Usher Parsons, M.D.    8vo. Boston, 1839.

On the Enlisting, Discharging, and Pensioning of Soldiers, by Henry

Marshall, F.R.S.E., with the Regulations for the Recruiting Service in the U. S. Army and Navy, with a Preface, by W. S. W. Ruschenberger, M.D. 8vo. Philadelphia, 1840.

A Treatise on the Diseases of the Breast, by Velpeau. Translated from the French, by S. Parkman, M.D. 8vo. Philadelphia, 1840.

Lectures on Retention of Urine caused by Stricture of the Urethra, and on the Diseases of the Prostate, by M. Amussat. Translated by J. P. Jervey, M.D. (Charleston.) 8vo. Philadelphia, 1840.

Memoir on the Radical Cure of Club-foot, by H. Scoutetten, M.D. Translated by F. Campbell Stewart, M.D. 8vo. Philadelphia, 1840.

On the Medical and Prophylactic Treatment of Stone and Gravel, with a Memoir on the Calculi of Cystine, by Civiale, D.M.P. Translated from the French, by Henry H. Smith, M.D. 8vo. Philadelphia, 1841.

Remarks on the Surgical Practice of Paris, illustrated by Cases, (Thesis,) by W. D. Markham, M.D. 8vo. Philadelphia, 1841.

Practical Surgery, by Robert Liston, Surgeon. 2d American from 3d London edition, with Additional Notes and Illustrations, by George W. Norris, M.D. 8vo. Philadelphia, 1842.

Elements of Surgery, by Robert Liston, with Copious Notes and Additions, by Samuel D. Gross, M.D. 8vo. Philadelphia, 1842–46.

Minor Surgery, or Hints on the Everyday Duties of the Surgeon, by Henry H. Smith, M.D. 12mo. Philadelphia, 1843.

The same, editions of 1846, 1850, and 1859.

A Practical Treatise on the Diseases of the Testis and of the Spermatic Cord and Scrotum, by T. B. Curling. Edited by Paul B. Goddard, M.D. 8vo. Philadelphia, 1843.

A System of Practical Surgery, by William Fergusson, F.R.S., with Notes and Additional Illustrations, by George W. Norris, M.D. 8vo. Philadelphia, 1843. The same, 4th edition, 1853.

A Treatise on the Diseases of the Eye, by W. Lawrence, F.R.S. Edited, with numerous Additions, by Isaac Hays, M.D. 8vo. Philadelphia, 1843, 1847, and 1854.

New Elements of Operative Surgery, by Velpeau. Translated from the French, by P. S. Townsend, M.D. Augmented by the addition of several hundred pages of entirely new matter, comprising all the latest improvements and discoveries in Surgery, in America and in Europe, up to the present time, under the supervision of, and with notes by, Valentine Mott, M.D. 3 vols. grand 8vo. New York, 1844.

The Principles and Practice of Modern Surgery, by Robert Druitt, Surgeon. Edited, with notes and comments, by Joshua B. Flint, M.D. 8vo. Philadelphia, 1844.

The same, edited by F. W. Sargent, M.D. 1848.

A Treatise on Operative Surgery, comprising a Description of the various Processes of the Art, including all the new Operations, (with lithographic plates,) by Joseph Pancoast, M.D. 4to. Philadelphia, 1844.

The same, 3d edition, revised and enlarged. Philadelphia, 1852.

Manual of Orthopœdic Surgery, being a Dissertation which obtained the Boylston Prize for 1844, on the question, "To what extent is the division of muscles, tendons, or other parts proper for the relief of deformities or lameness?" by Henry J. Bigelow, M.D. 8vo. Boston, 1845.

American Medical Biography, or Memoirs of Eminent Physicians, (and Surgeons,) embracing those principally who have died since the publication of Dr. Thacher's work on the same subject, by Stephen W. Williams, M.D. Greenfield, Mass., 1845.

Lectures on the Operations of Surgery, and on the Diseases and Acci-

dents requiring Operations, by Robert Liston, F.R.S., with numerous Additions, by Thomas D. Mütter, M.D. 8vo. Philadelphia, 1846.

A System of Surgery, by J. N. Chelius. Translated from the German, and accompanied with Additional Notes and Observations, by John F. South, (with additional references to the Surgical Literature of the United States, by G. W. Norris, M.D.) 8vo. Philadelphia, 1847.

On Bandaging and other Operations of Minor Surgery, by F. W. Sargent, M.D. 12mo. Philadelphia, 1847.

The Principles and Practice of Surgery, by George McClellan, M.D. Edited by his son, John H. B. McClellan, M.D. 8vo. Philadelphia, 1848.

On Etherization, with Surgical Remarks, by John C. Warren, M.D. 12mo. Boston, 1848.

Effects of Chloroform and of strong Chloric Ether as narcotic agents, (with statistics, post-mortem examinations, etc.,) by John C. Warren, M.D. Boston, 1849.

The Practice of Surgery, embracing Minor Surgery, by John Hastings, M.D. 12mo. Philadelphia, 1850.

On the Physiological Effects of Sulphuric Ether, and its Superiority to Chloroform, by Wm. T. G. Morton, M.D. 8vo. Boston, 1850.

A Practical Treatise on the Diseases and Injuries of the Urinary Bladder, the Prostate Gland, and the Urethra, by S. D. Gross, M.D. 8vo. Philadelphia, 1851.

A System of Operative Surgery, based upon the practice of Surgeons in the United States, with a Bibliographical Index and Historical Record of many of their operations during a period of 234 years, by Henry H. Smith, M.D. 8vo. with plates, Philadelphia, 1852.

The same, 2d edition. 2 vols. 8vo. 1855.

The Principles and Practice of Surgery, by Wm. Pirrie, Surgeon. Edited, with Additions, by Jno. Neill, M.D. 8vo. Philadelphia, 1852.

The Principles of Surgery, by Jas. Miller, 3d American from the 2d and enlarged Edinburgh edition. Revised, with Additions, by F. W. Sargent, M.D. 8vo. Philadelphia, 1852.

Illustrated Manual of Operative Surgery and Surgical Anatomy, by MM. C. Bernard and C. Huette, D.M.P. Edited, with Notes and Additions, etc., by Wm. H. Van Buren, M.D., and C. E. Isaacs, M.D. 8vo. (with plates,) New York, 1852.

On the Surgical Treatment of Polypi of the Larynx and Œdema of the Glottis, by Horace Green, M.D. 8vo. New York, 1852.

Hydatids of the Liver, Operation and Cure, by J. M. Weber, M.D. 8vo. New York, 1852.

Report of a Committee appointed by the American Medical Association on the Permanent Cure of Reducible Hernia, by George Hayward, M.D., Chairman, etc. 8vo. 1852.

Operative Surgery, illustrated, with explanatory text, by R. U. Piper, M.D. 8vo. Boston, 1852.

History of Kentucky Surgery, read before the Kentucky State Medical Society, at its annual meeting at Louisville, by Samuel D. Gross, M.D. 8vo. 1853.

A Treatise on Operative Ophthalmic Surgery, by H. Haynes Walton, Surgeon, first American from the first London edition. Edited by S. Littell, M.D. 8vo. Philadelphia, 1853.

The Practice of Surgery, by Jas. Miller, 3d American from the 2d Edinburgh edition. Edited, with Additions, by F. W. Sargent, M.D. 8vo. Philadelphia, 1853.

The Surgical Treatment of Fibrous Tumors of the Uterus, heretofore

considered beyond the resources of art, by Washington L. Atlee, M.D., Philadelphia, (Prize Essay of the American Medical Association.)   8vo. 1853.

Practical Observations on Aural Surgery, and the Nature and Treatment of Diseases of the Ear, with Illustrations, by Wm. R. Wilde.   Edited by Addinell Hewson, M.D.   8vo. Philadelphia, 1853.

Essay on a New Method of Treating Serpent-bite and other Poisoned Wounds, by Daniel Brainard, M.D., (pamphlet.)   Chicago, 1854.

A Practical Treatise on Foreign Bodies in the Air-passages, by S. D. Gross, M.D., with illustrations.   8vo. Philadelphia, 1854.

A Treatise on Venereal Diseases, by A. Vidal, (de Cassis,) with colored plates, translated and edited by George C. Blackman, M.D.   8vo. New York, 1854.

Outlines of the Principles and Practice adopted in the Orthopœdic Institution of Brooklyn, by Louis Bauer, M.D.   New York, 1854.

Diseases and Injuries of Seamen, with Remarks on their Enlistment, Naval Hygiene, and the Duties of Medical Officers, by G. R. B. Horner, M.D. 12mo. Philadelphia, 1854.

Clinical Lectures on Surgery, by M. Nelaton, from notes taken by Walter F. Atlee, M.D.   8vo. Philadelphia, 1855.

On the Treatment of Ununited Fracture by means of Artificial Limbs, etc., by Henry H. Smith, M.D., with wood-cuts.   Philadelphia, 1855.   (A pamphlet.)

Illustrated Manual of Operative Surgery and Surgical Anatomy, by MM. Ch. Bernard, M.D., and Ch. Huette, edited, with notes and additions, by W. H. Van Buren, M.D., and C. E. Isaacs, M.D., illustrated with colored steel engravings, by M. J. Levillé, M.D.   New York, 1855.

A Treatise on the Practice of Surgery, by Henry H. Smith, M.D.   8vo. Philadelphia, 1856.

Surgical Reports and Miscellaneous Papers on Medical Subjects, by G. Hayward, M.D.   12mo. Boston, 1856.

Hints on the Medical Examination of Recruits for the Army, adapted to the service of the United States, by Thomas Henderson, M.D.   Revised by Richard H. Coolidge, M.D.   12mo. Philadelphia, 1856.

History of Medicine, from its Origin to the Nineteenth Century, by P. V. Renouard, M.D.   Translated from the French, by Cornelius G. Comegys, M.D.   8vo. Cincinnati, 1856.

A Collection of Remarkable Cases in Surgery, by P. T. Eve, M.D.   8vo. Philadelphia, 1857.

Letters on Syphilis, by P. H. Ricord.   Translated by W. P. Lattimore, M.D.   8vo. Philadelphia, 1857.

On the Prominence of the Eyeball following the ordinary Operation for Strabismus, by Addinell Hewson, M.D.   Philadelphia, 1858.   (A pamphlet.)

Diseases of the Urinary Organs, a Compendium of their Diagnosis, Pathology, and Treatment, by W. W. Morland, M.D.   8vo. Philadelphia, 1858.

Manual of the Medical Officer of the Army of the United States—Part I. Recruiting and the Inspection of Recruits, by Chas. S. Tripler, M.D.   12mo. Cincinnati, 1858.

A System of Surgery, Pathological, Diagnostic, Therapeutic, and Operative, by Samuel D. Gross, M.D.   8vo. 2 vols. Philadelphia, 1859.

Malgaigne on Fractures, (and Luxations,) translated by John H. Packard, M.D.   Philadelphia, 1859.

A Treatise on Gonorrhœa and Syphilis, with eight colored plates, by Silas Durkee, M.D.   8vo. Boston, 1859.

Defects of Sight and Hearing, their nature, causes, prevention, and general management, by T. Wharton Jones, F.R.S. Edited, with additions, by Laurence Turnbull, M.D. 12mo. Philadelphia, 1859.

A Practical Treatise on Fractures and Dislocations, by F. H. Hamilton, M.D., (289 wood-cuts.) 8vo. Philadelphia, 1860.

A Practical Treatise on the Etiology, Pathology, and Treatment of the Congenital Malformations of the Rectum and Anus, by Wm. Bodenhamer, M.D. 8vo. New York, 1860.

Theory and Practice of the Movement-Cure, or Treatment by the Swedish System of Localized Movements, by C. F. Taylor, M.D. Philadelphia, 1861.

Lives of Eminent American Physicians and Surgeons of the 19th century. Edited by Samuel D. Gross, M.D. 8vo. Philadelphia, 1861.

Hand-Book for the Military Surgeon, by Chas. S. Tripler, M.D., U. S. Army, and George C. Blackman, M.D., F.R.M.S. 12mo. Cincinnati, 1861.

On Excision of Joints, by Richard M. Hodges, M.D. 8vo. Boston, 1861.

## AMERICAN MEDICAL JOURNALS

### FROM THE YEAR 1785 to 1862.

The following list includes only such journals as were accessible, and contained Surgical papers. Although it exhibits very many of the medical journals of this country, it is probable that it does not include all; editorial changes, and the irregular distribution of some of them, rendering it difficult for any individual to obtain accurate information respecting them, especially in relation to the Western journals. The matter in parenthesis ( ) is introduced as explanatory of the paper, and will not always be found in the original title.

Memoirs of the American Academy of Arts and Sciences. 4to. Boston, 1785–93.

Medical Papers, Communications, and Dissertations communicated to the Massachusetts Medical Society. To which are subjoined extracts from various authors, containing some of the improvements which have lately been made in Physic and Surgery. Published by the Society, in 2 vols. 8vo. Boston, 1790–1813.

Transactions of the College of Physicians of Philadelphia. 8vo. Philadelphia, 1793–1850.

The Medical Repository of Original Essays and Intelligence relative to Physic, Surgery, Chemistry, and Natural History; with a critical Analysis of recent publications on these departments of knowledge, and their auxiliary branches. 8vo. New York, 1797–1821. This was the first medical journal published in the United States, though the American Academy of Arts and Sciences, the Massachusetts Medical Society, and the College of Physicians, Philadelphia, which preceded it, published medical cases in connection with their proceedings.

The Philadelphia Medical and Physical Journal. Collected and arranged by Benjamin Smith Barton, M.D. 8vo. Philadelphia, 1804, 1805.

The Philadelphia Medical Museum. Conducted by John Redman Coxe, M.D. 8vo. Philadelphia, 1805–11.

The Medical and Agricultural Register for the years 1806, 1807, by Daniel Adams, M.D. 8vo. Boston.

The Baltimore Medical and Physical Recorder. Conducted by Tobias Watkins, M D. 8vo. Baltimore, 1809.

The New York Medical and Philosophical Journal and Review. 8vo. New York, 1809–11.

The American Medical and Philosophical Register; or Annals of Medicine, Natural History, Agriculture, and the Arts. Conducted by a Society of Gentlemen. 8vo. New York, 1811–14.

The Eclectic Repertory and Analytical Review, Medical and Philosophical. Edited by a Society of Physicians. 8vo. Philadelphia, 1811–20.

The New England Journal of Medicine and Surgery, and the collateral branches of Science. Conducted by a number of Physicians. 8vo. Boston, 1812–27.

Transactions of the Physico-medical Society of New York. 8vo. New York, 1817.

The Medical and Surgical Register; consisting chiefly of Cases in the New York Hospital. By John Watts, Jr., M.D., Valentine Mott, M.D., and Alexander H. Stevens, M.D. 8vo. New York, 1818.

The American Medical Recorder. Conducted by several respectable Physicians of Philadelphia. 8vo. Philadelphia, 1818–1829.

The Philadelphia Journal of the Medical and Physical Sciences. Supported by an Association of Physicians, and edited by N. Chapman, M.D. 8vo. Philadelphia, 1820–27.

The Journal of Foreign Medical Science and Literature, being a continuation of the Eclectic Repertory. Conducted by Samuel Emlen, M.D., William Price, M.D., and John D. Godman, M.D. 8vo. Philadelphia, 1821–24.

The New York Medical and Physical Journal. Edited by John W. Francis, M.D., Jacob Dyckman, M.D., and John B. Beck, M.D. 8vo. New York, 1822–29.

The Philadelphia Journal of the Medical and Physical Sciences. New Series. Edited by N. Chapman, M.D., and William P. Dewees, M.D. 8vo. Philadelphia, 1825–27.

The North American Medical and Surgical Journal. Conducted by Hugh L. Hodge, M.D., Franklin Bache, M.D., Charles D. Meigs, M.D., B. H. Coates, M.D., and René La Roche, M.D. 8vo. Philadelphia, 1826–1831.

The American Journal of the Medical Sciences. Edited by Isaac Hays, M.D. 8vo. Philadelphia, 1827–54. This journal contains the largest number of valuable papers of any journal in the United States.

The Boston Medical and Surgical Journal. (Published weekly.) 8vo. Boston, 1828–50.

The Transylvania Journal of Medicine, and the Associate Sciences. Edited by John Esten Cooke, M.D., and Charles W. Short, M.D. 8vo. Lexington, Ky., 1828–37.

The same, edited by Ethelbert L. Dudley, M.D., and H. M. Bullitt, M.D. 8vo. 1850.

The same, edited by L. J. Frazee, M.D. 8vo. Louisville, 1853.

The Monthly Journal of Foreign Medicine. Conducted by Squire Littell, Jr., M.D. 8vo. Philadelphia, 1828, 1829.

The New York Medical and Physical Journal. New Series. Conducted by Daniel L. M. Peixotto, M.D. 8vo. New York, 1829–31.

The Maryland Medical Recorder. Conducted by Horatio G. Jameson, M.D. 8vo. Baltimore, 1829–32.

The New York Medical Inquirer and the American Lancet, (late Medical Inquirer,) by an Association of Physicians and Surgeons. 8vo. New York, 1830.

New York Medico-Chirurgical Bulletin. Edited by George Bushe, M.D. 8vo. New York, 1831, 1832.

The Baltimore Medical and Surgical Journal and Review.    Edited by E. Geddings, M.D.    8vo. Baltimore, 1833–35.

The Medical Magazine.    Conducted by A. L. Pierson, M.D., J. B. Flint, M.D., and E. Bartlett, M.D.    8vo. Boston, 1833–35.

The American Lancet.    Edited by F. S. Beattie, M.D.    8vo. Philadelphia, 1833.

Southern Medical and Surgical Journal.    Edited by Paul F. Eve, M.D. 8vo. Augusta, Georgia, 1836.

The United States Medical and Surgical Journal.    Conducted by a number of respectable Physicians in various parts of the United States.    8vo. New York, 1834–37.

The same.    Edited by L. A. Dugas, M.D.    Augusta, Georgia, 1853.

Bulletin of Medical Science.    Edited by John Bell, M.D.    8vo. Philadelphia, 1837.

The American Medical Intelligencer.    Edited by Robley Dunglison, M.D.    (Containing reprints, translations, etc. of many excellent works.) 8vo. Philadelphia, 1837–42.

Medical Examiner and Record of Medical Science.    Edited by M. Clymer, M.D., and J. B. Biddle, M.D.    8vo. Philadelphia, 1837.

The same.    Edited by F. G. Smith, M.D., and J. B. Biddle, M.D. 8vo. Philadelphia, 1850.

New York Journal of Medicine and Surgery.    Edited by S. Forry, M.D.    New York, 1839–41.

New Orleans Medical and Surgical Journal.    Edited by A. Hiester, M.D.    New Orleans, 1844.

Illinois Medical and Surgical Journal.    Chicago, 1844.

Buffalo Medical and Surgical Journal.    Edited by Austin Flint, M.D. 1845.

New York Medical Gazette.    Edited by D. M. Reese, M.D., LL.D. New York, 1849.

New York Journal of Medicine and Collateral Sciences.    Edited by S. S. Purple, M.D.    New York, 1849.

St. Louis Medical and Surgical Journal.    Edited by Drs. Linton, Moore, McPheeters, and Jos. N. McDowell.    1849.

The Charleston Medical Journal and Review.    Edited by P. C. Gaillard, M.D., and H. W. De Saussure, M.D.    Charleston, 1849.

The Western Lancet and Hospital Reporter.    Edited by L. M. Lawson, M.D., and John P. Harrison, M.D.    Cincinnati, Ohio, 1849.

New York Register of Medicine and Pharmacy.    Edited by C. D. Griswold, M.D.    New York, 1850.

The Ohio Medical and Surgical Journal.    Edited by S. Hanbury Smith, M.D.    Columbus, Ohio, 1850.

The same.    Edited by Richard L. Howard, M.D.    Columbus, Ohio, 1853.

The New Jersey Medical Reporter, and Transactions of the New Jersey Medical Society.    Edited by Joseph Parrish, M.D.    Burlington, N. J., 1850.

Western Journal of Medicine and Surgery.    Edited by Lunsford P. Yandell, M.D.    Louisville, 1850.

The Stethoscope and Virginia Medical Gazette.    Edited by P. Claiborne Gooch, A.M., M.D.    Richmond, Va., 1851.

The North-Western Medical and Surgical Journal.    Edited by W. B. Herrick, M.D., assisted by H. A. Johnson, M.D.    Chicago, 1852.

The New York Medical Times.    Edited by Henry D. Bulkley, M.D. New York, 1852.

Nashville Journal of Medicine and Surgery.   Edited by W. R. Bowling, M.D., and Paul F. Eve, M.D.   Nashville, Tenn., 1852.

The New Orleans Monthly Medical Register.   By A. Forster Axson, M.D.   New Orleans, 1852.

The New Orleans Medical and Surgical Journal, devoted to Medicine and the Collateral Sciences.   Edited by A. Hiester, M.D.   New Orleans, 1852.

American Lancet and Monthly Journal of Practical Medicine.   Edited by Horace Nelson, M.D.   Plattsburg, N. Y., 1853.

The New Hampshire Journal of Medicine.   Edited by Edward H. Parker, A.M., M.D.   Concord, N. H., 1853.

The East Tennessee Record of Medicine and Surgery.   Edited by Frank A. Ramsay, A.M., M.D.   Knoxville, Tenn., 1853.

The Virginia Medical and Surgical Journal.   Edited by George A. Otis, M.D., and Howell L. Thomas, M.D.   Richmond, Va., 1853.

Southern Journal of Medical and Physical Sciences.   Edited by Drs. King, Jones, Ramsey, Currey, Wood, Atchison, and Scruggs.   Nashville, 1853.

American Lancet and Monthly Journal of Practical Medicine.   Edited by Horace Nelson, M.D.   Plattsburg, N. Y., 1853.

Peninsular Journal of Medicine and Collateral Sciences.   Edited by E. Andrews, A.M., M.D.   Ann Arbor, Michigan, 1853.

Kentucky Medical Recorder.   Edited by H. M. Bullett, M.D., and R. J. Breckinridge, M.D.   New Series, Louisville, Ky., 1853.

The Maryland and Virginia Medical Journal.   Edited by J. B. McCaw, M.D., and W. C. Van Bibber, M.D.   1860.

The Southern Medical and Surgical Journal. Edited by Henry F. Campbell, M.D., and Robert Campbell, M.D.   1860.

Charleston Medical Journal and Review.   Edited by J. Dickson Bruns, M.D.   1860.

The New Orleans Medical and Surgical Journal.   Edited by Bennet Dowler, M.D.   1860.

The Chicago Medical Journal.   Edited by Daniel Brainard, M.D., and E. Ingals, M.D.   1860.

Louisville Medical Journal.   Edited by Thos. W. Colescott, M.D.   1860.

The Columbus Review of Medicine and Surgery.   Edited by W. D. McMillen, M.D.   1860.

The Savannah Journal of Medicine.   Edited by Juriah Harriss, M.D.   1860.

The Medical Journal of North Carolina. Edited by Edward Warren, M.D.   1860.

Louisville Monthly News.   Edited by J. W. Benson, M.D.   1860.

The New Orleans Medical News and Hospital Gazette.   Edited by D. W. Brickell, M.D., and E. D. Fenner, M.D.   1860.

Nashville Journal of Medicine and Surgery.   Edited by W. R. Bowling, M.D.   1860.

Atlanta Medical and Surgical Journal.   Edited by J. G. Westmoreland, M.D.   1860.

Oglethorpe Medical and Surgical Journal.   Edited by Drs. H. L. Byrd and W. Hauser.   1860.

The Georgia Medical and Surgical Encyclopædia.   Edited by H. N. Hollifield, M.D., and S. W. Newsome, M.D.   1860.

The Saint Joseph Medical and Surgical Journal. Edited by G. C. Catlett, M.D., and J. B. Snelson, M.D.   1860.

Nashville Medical Record   Edited by J. J. Abernathy, M.D., T. L. Maddin, M.D., and J. H. Callender, M.D.   1860.

The North American Medico-Chirurgical Review. Edited by S. D. Gross, M.D., T. G. Richardson, M.D., and S. W. Gross, M.D.    1861.

The Berkshire Medical Journal.   Edited by William Henry Thayer, M.D., and R. Cresson Stites, M.D.    1861.

American Medical Times.    1861.

The Cincinnati Lancet and Observer.   Edited by Drs. Stevens, Murphy, and Weber.    1861.

The Columbus Review of Medicine and Surgery.    Edited by W. L. McMillen, M.D.    1861.

St. Louis Medical and Surgical Journal.   Edited by M. L. Linton, M.D., and W. M. McPheeters, M.D.    1861.

The Ohio Medical and Surgical Journal.   Edited by John Dawson, M.D., and J. W. Hamilton, M.D.    1861.

Buffalo Medical and Surgical Journal and Reporter.   Edited by Julius F. Miner, M.D.    1861.

The Cincinnati Medical and Surgical News.   Edited by A. H. Baker, M.D., and J. A. Thatcher, M.D.    1861.

The Medical and Surgical Reporter.   Edited by S. W. Butler, M.D., and R. J. Levis, M.D.; L. C. Butler, M.D., Assistant Editor.    1861.

The Pacific Medical and Surgical Journal.   Edited by David Wooster, M.D.    1861.

Cleveland Medical Gazette.    Edited by Drs. Weber, Stevens, and Murphy.    1861.

The Chicago Medical Examiner.   Edited by N. S. Davis, M.D., and F. W. Reilly, M.D.    1861.

The American Medical Monthly.   Edited by J. H. Douglas, M.D. 1861.

The San Francisco Medical Press. Edited by E. S. Cooper, M.D. 1861.

The Boston Medical and Surgical Journal.    Edited by F. C. Oliver, M.D., and Calvin Ellis, M.D.    1861.

The New Orleans Medical Times.    Edited by A. Peniston, M.D.    1861.

The Baltimore Journal of Medicine.   Edited by E. Warren, M.D.    1861.

The Summary of Medical Science.   Edited by W. R. Wells, M.D.    1861.

# THE PRINCIPLES

AND

# PRACTICE OF SURGERY.

## INTRODUCTORY REMARKS.

In commencing the investigation of any subject, it is usually found highly conducive to sound progress to obtain first a general idea of its extent, variety, and character, and then to proceed more systematically to the examination and study of its different parts. In studying the *Principles and Practice of Surgery* or External Pathology, this course is especially necessary, the distribution of the various departments of the healing art being so purely arbitrary as not distinctly and accurately to separate one portion from another. In fact, it is almost impossible so to methodize "the ills that flesh is heir to," as to limit the consideration of their effects to any one region or portion of an organism which, like that of man, is composed of a multiplicity of parts, all regulated by a common force, and all more or less dependent on each other's action for the perfect and easy performance of the functions specially their own.

Admitting that such external disorders as are usually denominated *Surgical* are often accompanied by symptoms of internal derangement similar to those which characterize the class assigned to the practice of medicine, the following pages may justly be limited to those points of General Pathology and Therapeutics that are by usage and common consent regarded as peculiarly within the province of Surgery.

From the early signification given to the word Surgery, Chirurgie, (χειρ, the hand, and εργον, work,) it is evident that surgical disorders have long been regarded as those mainly or prominently requiring a manual or mechanical treatment. Yet, as these means, acting on a vital organism, necessarily modify its normal action, the organic laws in health, as demonstrated by Physiology, and those of disease, as exhibited by Pathology, with the means of relief presented in Physics and General Therapeutics, necessarily become important subjects of study, and constitute the Science and Art of Surgery.

The subject thus named is usually presented by surgical writers under two distinct heads: one, the *"Principles of Surgery,"* embracing all the theories and laws of the *Science;* the other, the *"Practice of Surgery,"* exhibiting the judicious application by *Art* of the principles that science establishes, and (as has been well observed) naught but violence can separate these heads.   "Without the test of experience in art, the value of theoretical rules, as elaborated by science, cannot be decided ; while art in all its branches has been always amenable to those closet speculations and general inductions that are based on a careful analysis and mental digest of the facts collected by clinical observation."

As both the Principles and the Practice of Surgery are equally important in their proper place, they have in many instances constituted the subject of distinct treatises; but in the following pages it is proposed so to blend and combine the outlines of each, as to render them more readily appreciable by the student.

In the arrangement of the work, reference will first be made to those points of such general interest that, as Richter has said, "there is scarcely a surgical malady in which they are not to be noted either as the cause, symptom, or result;" after which will be presented such disorders of special tissues and regions as will give a correct outline of the varied information required of him who proposes to become a surgeon.

# PART I.

## GENERAL SURGICAL PATHOLOGY AND THERAPEUTICS.

For the advantages of systematic study, we shall present in this part, under the head of Surgical Pathology and Therapeutics, those general facts that bear on the investigation of the results and characteristic signs of surgical disorders, as well as such remedies as are demanded during some portion of their treatment, considering the first under the head of Surgical Pathology, the latter under that of Surgical Therapeutics.

## CHAPTER I.

### MODIFICATIONS OF HEALTHY NUTRITION.

**Surgical Pathology,** a branch of **General Pathology,** embraces the consideration of the nature of those abnormal conditions that constitute disorders that are by common consent assigned to the care of the surgeon.

All diseases, being the result of a departure from *health*, may be studied either as exhibited in the disordered action noted in special tissues, or in that seen under very much the same general characteristics wherever developed; hence they are divided, for systematic reference, into *special and general disorders*. To the latter, in connection with the province of surgery, attention is now asked, as the comprehension of certain general principles, thus established, will facilitate the subsequent study of the modification of diseased action met with in special localities.

*Health* being dependent on the continued normal state of each component part of the organism, and being maintained and developed by a series of acts designated as **Nutrition,** a brief reference to the views of physiologists on this process will tend to the elucidation of points in *disease*, or that condition resulting in or from a modified nutritive action.

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## SECTION I.

### OUTLINES OF THE NORMAL NUTRITIVE PROCESS.

Nutrition has been well defined by physiologists "as that modification of the formative process peculiar to living bodies, by which the tissues and organs already formed maintain their integrity."

Microscopic investigation having shown that all tissues and organs are formed of a series of minute elementary atoms termed *cells*, the nutrition of each part is largely due to *cell action*. In this action, each series of organic cells causes the material supplied by the blood to take such form and power as enables it to participate in the vital changes that characterized the original cell.

In order that the process of nutrition may be properly accomplished, there must be—first, a normal cell action ; second, a proper condition and supply of blood ; third, a proper nervous or life force to regulate all. As these conditions originate in the earliest acts of life, they continue, when once established, for a varying period. Hence the study of the nutritive process that maintains life has been justly commenced at the very earliest periods of the formative power, as noted in the ovum.

The careful observations of embryologists, from the period of the impregnation of the ovule to the natural termination of life, have established as well-settled facts four well-marked periods :—

1st. That of **Development**. 2d. **Growth**. 3d. **Adult Life**. 4th. **Old Age** and **Death**. And these periods have a marked influence on the process of nutrition.

Throughout the period of development, the most remarkable phenomena connected with nutrition are displayed during *intra-uterine* existence, and are concerned in the production of *form*.

Without entering into the details of a period which especially belongs to embryology, it may be observed that the intra-uterine development of the ovum, as connected with its nutrition, presents the gradual evolution of complexity out of simplicity, or the formation of complex tissues and organs out of simple cells, the ovum, at the moment when the process of segmentation is completed, consisting of an aggregation of nucleated cells that are alike in size, shape, appearance, and composition, so far as can be shown by the most careful microscopical and chemical investigations.

As life progresses, various transformations of these occur, and are exhibited first in the variation of shape between the cells of its serous and mucous layers, and at a later period in the evolution from the embryonic cells of the anatomical elements of the several tissues.

But although the most remarkable phenomena of development are displayed during the intra-uterine period, very many changes due also to nutrition are manifested during *growth*, in the alteration of shape, etc., by which the organs of the infant eventually assume the characters of those seen in the adult.

*The period of growth* is most marked between birth and puberty, and consists in the achievement of *size*. It is, however, rarely uncombined with development in the normal history of the organism. During the period of intra-uterine existence, growth, or the result of nutrition, is manifested in the increase of the embryo from a microscopic object to the full size of the fœtus at term.

*The period of adult life* is essentially the period of nutrition, as shown

in assimilation or maintenance ; the forces of the organism being now only adequate to preserve it in the condition already attained, and to repair the waste which is constantly progressing. This it does through the process of assimilation, though this action is not confined to adult life, being coexistent with development and growth, manifested from the beginning of existence, and, though more or less impaired, continued until death.

*The period of old age* is characterized by feeble nutrition and a progressive atrophy and decay. Involution has now succeeded evolution. The several degenerations hereafter described under the head of atrophy appear in most of the tissues and organs of the body, and the entire system of man is gradually prepared for the closing scene of death—the end of life.

Such, in a few words, is the general life of the animal organism. But though the life of individual organs is similar in its general outline to that of the entire body, it does not always coincide with it in point of time ; certain organs running normally through all their four stages before the entire organism has fully completed its first two ; examples of which may be found in the thymus gland and other fœtal organs which begin their involution long before the evolution of the whole body is complete. The premature decay which occurs in these glands normally may also be the result of disease in any or all the organs of the body, of which we have an example in atrophy.

Still more striking is the contrast as to the duration of existence in the elementary particles out of which the several organs are built—it being well known, as before stated, that all the tissues of the body are composed of such minute anatomical portions or elementary organs (cells and their derivatives) as can only be satisfactorily studied by the aid of the microscope of 200–500 diameters' magnifying power.

These elementary cells are created, grow, and exist, fully formed in the adult stage, for a variable period, and then degenerate and die, the outlines of their history being similar to those of the history of the entire organism, although the time occupied in the changes is far more brief, as innumerable cells are created, die, and are cast off during the life of every organ and structure.

In the preservation of life, whether of a tissue or of the entire organism, nutrition consists in the performance of two distinct offices : in one material is furnished for the formation of the new cells, whose destiny is to replace those whose existence has terminated ; while in the other there must be some means of supplying the waste of the proximate organic principle constantly going on even in those textures in which the organic forms are permanent. This material is furnished by the process of assimilation and digestion—the new material being poured into the blood, and supplied to each tissue and organ by its own series of blood-vessels. From the liquor sanguinis there is a constant metamorphosis carried on in the interstices of the tissues, by which each class of structure cells appropriates to itself that which it wants. Whatever is superfluous in the nutritive supply, together with the excrementitious products of the molecular changes, is taken up again by the connective tissue cells or by the lymphatics, and again introduced into the great current of the circulation.

Assimilation and the maintenance of life, or nutrition, is thus shown to consist in a process that is essentially formative on one hand and destructive on the other. So long as these processes are mutually balanced, the normal condition of the body is maintained. During the period of *growth*, the formative process is in excess and the organs severally increase in size. Growth is, therefore, a modification of assimilation. When a marked disproportion is created, this increase of size may become very obvious, and diseased action is established. When the disproportion between the forma-

tive and destructive process results in abnormal overgrowth, it is designated as *Hypertrophy*.  When, toward the close of adult life, involution or destruction is more decided than evolution or development, the destructive action predominating over the formative, various changes occur which are progressively striking as old age advances.  When a similar excess of the destructive processes over the formative is noted in one or more organs of the body, it is designated as *Atrophy*, as will be subsequently explained.

While most physiologists, at the present period, acknowledge the general correctness of the preceding views of development and growth of the varied tissues and organs of the body, they differ in their explanations of the manner in which these changes are accomplished.  Hence the different theories of new formations, and hence the different doctrines that have from time to time ruled the profession in its explanation of the cause and progress of disease.

By the *Humoralists* the regulating power in disease was supposed to exist in the blood or humors of the body, which thus modified—in accordance with its composition—the condition of the parts which it supplied.  The *Solidists*, on the contrary, regarded the mechanical or dynamical action of the organs and tissues as especially important; while the *Vitalists* thought every change was influenced or created by an *Archæus* spirit or vital principle.  These theories, under the dominant influence of varied anatomical, chemical, and physiological discoveries, yet continue to influence to some extent the sentiments of the profession, the dominant one in pathology at this date apparently being that of the Solidists in a modified form.

Among the most distinguished of Continental writers on the forces regulating normal nutrition is Professor Virchow, of Berlin, whose recent treatise on "Cellular Pathology as the Foundation of Physiological and Pathological Tissue Doctrine"* has attracted much attention, and seems likely to exercise great influence on the views of physiologists respecting nutrition.

Among English physiologists, Addison had previously called attention† to the importance of cell action in nutrition, he regarding each series of cells as endowed with a peculiar "irritability or elective affinity by which it is impelled to certain actions peculiar to its class."  Every tissue and organic cell, according to Addison, "is a unit of life manifesting by its reaction—whatever that may be—the appearance of life."  Hence, according to this affinity, the cells composing the substance of the liver have one function or action; those composing the kidney another, one forming bile and the other urine out of the elements brought to their neighborhood by the blood-vessels.  So, in the tissues, the cells of the periosteum develop bone, and those of cuticle form cuticle, periosteal cells not being able to form cuticle, and *vice versa*.

In regard to the original formation of the primitive cells, whose creative power is thus transmitted to generation after generation through the process of nutrition and development, and whose modified action constitutes disease, there is yet a diversity of sentiment—Schleiden and Schwann originally regarding these cells as developed out of an amorphous blastema by the formation of *granules, nucleoli*, and *nuclei*, thus maintaining that a cell could arise without a pre-existing cell simply through a "*germ force*," by changes in exudations from the blood-vessels; while Virchow maintains that "all cells are the result of the multiplication of pre-existing cells, to which they stand in the relation of progeny to parents"—"Omnis cellula e cellula."  Virchow denounces, therefore, Schwann's doctrine of *free-cell* development as retaining in histology that theory of spontaneous or

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* Berlin, 1858.                                    † Cell Therapeutics.

equivocal generation so long abandoned in natural history, and declares that he can as readily admit the spontaneous generation of an intestinal worm as believe that a nucleated cell can originate out of a formless liquid.    According to his view of the normal processes of development and growth, the parts enlarge either by a direct increase in bulk of the elementary parts, or if, as frequently takes place, these increase in *number*, the increase is effected by the multiplication of old cells, and not by the formation of a new one out of a formless liquid.

The cellular elements of all pathological new formations, as lymph, pus, tumors, cancer, etc., pursue a similar course, being formed, according to this distinguished observer, by the multiplication *by division* of the tissue cells of the part affected, and most frequently, though not always, by the multiplication of the connective tissue corpuscles, or those minute, spindle-shaped or stellate cells which exist imbedded in the connective tissue that forms the stroma of every organ of the body.

In accordance with this doctrine, the first effect of the irritation producing an inflammation is to cause the elementary cells of the part to manifest their capability of reaction by taking up more material into their substance, enlarging, and becoming turbid and granular.    At a subsequent period the cells begin to multiply, their progeny undergoing various developments or degenerations in accordance with the constitutional or local condition, thus constituting the several metamorphoses or *products* of inflammation, as hereafter stated.

Without attempting to advocate the correctness of any of these theories, it will serve our present purpose to state—1st. That, in accordance with the generally received doctrines, Every tissue and organ is to be regarded as composed of cells.    2d. Every class of cells is endowed with an independent life, as shown by their reactions when stimulated.    3d. That, when the stimulus or irritation is natural or healthy, the result is a normal nutrition.    4th. That when the stimulus is unnatural—that is, either above or below the normal standard—we will have either excessive or diminished reaction.  According to Virchow,* degeneration of every variety is evidence of a modification of life force, the destruction of the cell action being designated by the term *necrobiosis*, or death of life force, as suggested by Schulze.    By the loss of life force all the tissues and organs of the economy are constantly changing, though the change is so gradual and imperceptible as not to be recognized by ordinary observers.

While all admit that the blood furnishes the material from which each class of tissue cells receives that which is necessary to its own preservation, the question as to the manner in which this is obtained is yet a subject of discussion.    As explained by Virchow, Addison, and the advocates of " cell force," the supply is regulated by the amount drawn from the adjacent blood-vessels by the healthy activity or increased irritability of the cells composing the part.

Bennett and his school, on the contrary, regard all local changes in nutrition and development as due to an *exudation* from the blood-vessels of a plasma or blastema, in which cell action is induced by the production of changes that create cells, the whole process of local nutrition and decay being mainly dependent on the composition and constituents of the blood. What regulates the amount of the material exuded is not clearly stated. Both admit the importance of the liquor sanguinis—the chief difference being in their explanations as to the mode in which the nutritive elements

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* Op citat.

are taken out of it and appropriated by the cells of the tissues concerned in the process.

Without further reference to theoretical points, we may correctly admit that a full supply of blood is essential to all growth or development, and that the character of the liquor sanguinis materially affects the process of repair, or that process of development to which the surgeon owes so much of his success in the cure of the injuries committed to his care.

## SECTION II.

### DISORDERED NUTRITION AS SHOWN IN HYPERTROPHY AND ATROPHY.

#### § 1.—Hypertrophy.

The perusal of the foregoing section will prepare the student for the investigation of hypertrophy, or that condition which has been defined as an *abnormal increase in the size of an organ, resulting from preternaturally augmented but normal nutrition.* Such a definition, it will be perceived, at once excludes the condition designated by some writers as " false hypertrophy," by which is understood an apparent increase of size, due to the presence of some pathological new formation in the substance of the organ. False hypertrophy, therefore, belongs properly to the category of new formations, and will not be alluded to in this place.

The causes of hypertrophy are usually arranged under two general heads :—

I. Increased exercise of function.

II. Increased supply of plasma.

That the healthy exercise of function augments the nutritive activity of parts is well known to every student of physiology.     While it is also known that the destructive metamorphosis is accelerated by this activity, as is shown for example in the case of the muscles, where the increase of nitrogenized excreta after exercise is very evident, though the reparative process is also often augmented in a much higher degree.     The physiological working of this law may be illustrated by reference to the notable muscular development of those parts of the body which are brought into active exercise by certain trades and callings, as in the arms of the blacksmith, or the calves of the plowman.

Increased size in a much more marked degree often occurs in certain organs in consequence of an augmentation of function which is the result of disease elsewhere : as an example of which we may cite hypertrophy of the heart from excessive efforts to overcome the obstruction offered to the circulation by valvular disease ; or hypertrophy of the muscular coat of the bladder from excessive efforts to expel the urine in cases of stricture of the urethra, etc. etc.

It will readily be understood then that it becomes a point of some difficulty to determine in any case whether the degree of overgrowth is sufficient to justify the designation of hypertrophy ; and Mr. Paget has proposed to confer precision upon this term by limiting it to those cases in which the excessive growth in one part is the result of disease in another.

Hypertrophy may also result—apart from excessive exercise of function— in organs which have been long the seat of active hyperæmia.     Such for example is the hypertrophy of the lanuginous hairs in the neighborhood of

chronic leg ulcers, or stumps which have been long inflamed;* or the hypertrophy of the shaft of a long bone, a part of which is the seat of necrosis,† etc. etc.   A nice question might arise as to whether in fact increased exercise of function does not determine hypertrophy by inducing an increased flow of blood to the part, and thus supplying the second condition, superabundant plasma.

With regard to the minute anatomical conditions present in hypertrophied parts much might be said.   The subject is one of interest, but it has not yet been fully investigated.

### § 2.—Atrophy.

**Atrophy** may be defined as a *diminution in the bulk, accompanied, generally, by more or less degeneration of the structure of parts*, resulting from the predominance of the destructive over the reparative processes of nutrition.

The causes giving rise to this condition are found in whatever diminishes the quantity or quality of the nutritive material furnished to a part by the blood or the forces by which, in the healthy state, it should be appropriated. In atrophy we therefore recognize a failure, to a greater or less extent, of the normal cell action of the part affected, whether due to a want of proper cell irritability or to a deficient supply of blood.   In the latter case the pressure of tumors, aneurisms, etc. upon the vessels of a part by cutting off the vascular supply often become the cause of atrophy.   Paralysis or deficient nerve force also exercises a marked influence on local nutrition, and, hence, paralyzed parts become more or less atrophied, as is frequently observed in the limbs, or more rarely in the case of a single muscle, as may often be witnessed in the deltoid muscle after falls and blows upon the shoulder, which involve the muscular nerves.   That alterations in the quality of the nutritive fluids may produce atrophy and degeneration, is daily seen in the general emaciation, accompanied often by marked fatty degeneration of the heart, liver, and other organs in the latter stages of the anæmia of tuberculosis or cancer.

The minute anatomical conditions of atrophied parts present many points of interest to which we cannot here allude, except to say that a certain degree of atrophy may exist without any very great structural alterations, though, as a general rule, atrophy is accompanied in a more or less marked degree by one of the following degenerations of the component cells of the part affected:—

I. **Fatty degeneration,** which is by far the most common, and has been most thoroughly studied.   This consists essentially in the more or less complete transformation into oil of the proximate principles of which the organic cells involved are composed, and is shown in a general way by the unnatural greasiness of the tissue affected; by its tawny or yellowish color, and by the excessive quantity of ether extract which it yields.   Microscopically it is recognized by the presence of innumerable oil drops, of variable size, in the fluid contents of the cells; in their walls; in the very substance of fibres and membranes, and in the fluid plasma or solid matrix (intercellular tissue) which lies between the cells.   The textures thus affected become preternaturally soft; their functions are imperfectly performed, and they may actually be transformed, in some extreme cases, into a soft, pulpy or fluid mass, as happens occasionally in the case of cartilages, as described by Redfern, and especially in certain degenerating new formations, such as tubercle or cancer.

It will be seen, when we come to the study of inflammation, that fatty degeneration frequently exists in the substance of inflamed parts, and thus produces inflammatory softening, and also ulceration. Moreover, in the study of the products of inflammation, and in the history of new formations generally, fatty degeneration plays a conspicuous part, as will be seen hereafter.

II. **Calcareous degeneration.**—This degeneration manifests itself by the preternatural presence in the affected texture of various earthy salts, especially the carbonate and phosphate of lime. Calcareous degeneration is frequently associated with fatty degeneration, as, for example, in *atheromatous* disease of the arteries, where it produces the condition formerly described as ossification of the vessels.

III. **Horny degeneration.**—Horny degeneration, withering, or obolesence, is displayed by the shriveling and drying of the affected parts, which become smaller, and lose their natural juices or succulence. This mode of degeneration, as well as those above described, may be observed in pathological tissues and semi-organized transudations, as well as in the healthy structures of the body, but is less frequently seen.

Having thus briefly alluded to a few general points of healthy nutrition that are essential to a correct comprehension of such diseased action as comes within the province of the surgeon, we may next advantageously examine the general symptoms that indicate the existence of disease.

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# CHAPTER II.

## SURGICAL SEMEIOLOGY.

THE correct investigation of the elements of a disorder being essential to a recognition of its presence, the first subject to which attention should be directed is Surgical Semeiology, or that portion of pathology which teaches the signs or symptoms of surgical disorders.

Of these signs some are equally applicable to many complaints, and may be studied together, being rather generic in their character; while others, which are more specific, can be best alluded to under the particular head to which they belong. Presuming that the student is acquainted with the anatomy and physiology of the human frame, we shall at once proceed to examine—First, such signs of surgical disorders as in most instances are exhibited on the exterior of the body; and, second, such as are to be noticed in connection with the action of the internal organs.

## SECTION I.

### OF THE SIGNS TO BE NOTED ON THE EXTERIOR OF THE BODY.

Health being the result of the perfect action of normal organs, any departure from their original condition will develop changes that constitute disease. In that class of disorders assigned to the surgeon, the outward man, or his more external organs, are those most directly affected, either in consequence

of the disordered action of internal parts, or from external violence. The general condition of the exterior of the body should, therefore, first attract our attention; and as the carriage, posture, shape, color, temperature, and sensibility are often directly affected by injuries, these should be carefully noted in forming a diagnosis.

### ¿ 1.—Of the Carriage or Posture of a Patient.

The carriage of man, when in the full possession of all his powers, is naturally erect and heavenward, but no sooner is he struck by the blight of severe injury than he droops and sinks to the earth.

The variations from the erect posture will, therefore, not unfrequently indicate the extent of his injury.

As a general rule, the *supine position*, or that in which all the limbs are relaxed and the body alone supported by artificial means, if the result of violence, will usually indicate muscular debility or serious depression of the nervous system, all parts of the body being dependent on this great centre for their lifelike force. The doubling of the body *forward*, or that position in which the limbs are drawn up toward the chest, usually shows abdominal trouble; while its rigidity backward, or extreme extension, or tendency to approximation of the heels and head, shows a derangement in the contents of the spinal canal.

The *sitting posture* may be the result either of partial external injury, by which the patient is prevented from standing, or it may follow an effort to leave the recumbent position when the strength is not yet sufficient to enable him to rise entirely.

The *relaxed condition of the extremities*, or their *fixedness in unnatural positions*, is also often an important sign as indicating injuries by which muscular action is more or less impaired. The power of moving a limb or any portion of the body, without its quivering or being unsteady in its movements, shows perfect health; but a trembling motion, imperfect elevation, or unnatural flexion or extension, tell most truly of disorder either in the parts devoted to locomotion or in the nerve centres which regulate them. In health, the mechanical movements of the body and limbs are all perfect and easy, while in the injured or diseased condition, the derangement may be readily recognized by the labored and imperfect action.

In order thoroughly to examine the mechanical actions of a patient, it sometimes happens that the surgeon will be compelled to carry him through a regular set of motions, to enable him to decide which portion of his body is disordered. In the stiffness of joints, power of muscles, action of limbs, etc., such a direct observation can alone show the seat of the disorder. When, then, an examination of a patient is required under such circumstances, he should be entirely deprived of covering on the part to be inspected; if in the body, by the removal of all clothing, except drawers, etc ; and if in the lower extremities, by the retention only of the body clothing. But when a partial exposure circumscribes the view, and the nature of the injury demands it, entire nudity, as practiced by army and navy surgeons in the inspection of recruits, affords decidedly the best opportunity of arriving at a correct conclusion. In making such an examination, the surgeon should place himself about six feet from the patient, and direct him to stand erect and face him. When thus arranged, proceed to inspect, first, his general carriage, as the position of his head, the level of his shoulders, the fullness of his chest and abdomen, and the position of his legs and feet. After which make a more special observation of particular parts, examining the motion of his arms, by making him

raise them over his head; move them in a horizontal position; make the back of the hands touch behind his back, etc. Then, in examining his other movements, direct him to bend his body until the points of his fingers touch the ground; to straighten himself again; to open and close his hand; flex and extend each finger; pronate and supinate his hand, etc.

Next, let the patient be made to walk toward and from his examiner; to bend and straighten each limb, extend and flex each foot, stand on one leg, and, in fact, pass through these and such other movements as will show clearly his power to perform all the natural motions of each portion of his frame. This kind of examination, though not often required, will be found especially useful in detecting injuries about the hip-joint or spine, cases having been frequently thus recognized at a glance, which had escaped the most careful measurement and merely local examination.

## § 2.—Of Physiognomy.

The inspection of the countenance or physiognomy, so often trusted to in the judgment of moral character, is not less useful in the formation of an opinion of physical disorder. A lively countenance indicates not only mental but corporeal health and comfort, while a distressed or distorted expression shows as truly the reverse.

The sharp nose, knitted eyebrows, hollow, sunken eyes, tenseness of skin, and leaden or livid hue of the "Facies Hippocratica," indicate the approach of death or of extreme exhaustion. A pinched character of the features often accompanies peritonitis; the "Risus Sardonicus," or spasms of the lips and cheeks, frequently precedes or accompanies tetanus; while the involuntary contraction of the mouth, tongue, etc. shows an injury near the nerves which supply these parts. Frowning is sometimes indicative of pain in the head or eyes; distention of the nostrils, of pain in the chest or difficult respiration; and a contraction of the angles of the mouth, with a compression of the lips against the gums, is often the result of rectal or vesical straining.

But, in addition to its expression, the *color* of the face will occasionally indicate the danger from disease or injury. A purple or livid tint may show an injury to the chest involving the organs of respiration; a leaden or sallow hue is characteristic of the constitutional disturbance of cancer; pallor of countenance nearly always supervenes on excessive loss of blood; and a yellow, jaundiced color has been known to follow serious gunshot wounds, as well as fractures involving large joints. Concussion of the brain creates pallor; depressed fracture of the skull, strangulation, drowning, etc. produce more or less relaxation of the facial muscles, and a disposition to puffiness in the cheeks, on expiration, which, once seen, will readily be recognized.

## § 3.—The Shape and Size of a part.

Differences in the *shape and volume* of the part under consideration, and especially of the extremities, are the grand rallying points of the surgeon in cases of injury. These signs necessarily require a comparison of the different sides of the body, allowance being made for the increased development of the whole right side, from its being usually the most exercised, as may be learned by simple inspection, palpation, or mensuration. The *enlargement* of any region may show the formation of unnatural growths in the deep-seated tissues; or the development of air, as in the emphysema of gangrene or of wounds about the chest; or the existence of matter, or of

unnatural secretions, as seen in elephantiasis, in tumors, suppurations, synovial degenerations, etc.; while the *diminished size* of a region often indicates atrophy, loss of muscular power, or an uunatural relation of parts, as seen in injuries of the deltoid muscle, luxations of the shoulder or hip, depressed fracture of the skull, ribs, etc.

Variation in *length* is usually limited to the extremities, and indicates changes in the natural relations of the articulating surfaces of the bones, or solutions of their continuity.    It is mainly valuable in diagnosticating fractures and dislocations; and whenever measurement is resorted to for a knowledge of the length of the upper extremities, it should be made between two well-known aud fixed points, as from the acromion process of the scapula to the condyles of the humerns, or from the condyles or olecranon process to the styloids of the radius or ulna.    But in the lower extremities, in addition to the selection of two fixed points—as the anterior superior spinous process of the ilium, and the internal malleoli of the tibiæ—the surgeon must also see that the pelvis is straight and at its proper level with the spine, otherwise he will be misled.    If a line carried from one spinous process to the other cuts the median line of the abdomen at a right angle, there can be no error of measurement from this cause; but if it does not, and the pelvis is iuclined either to the right or left side, there will be a corresponding increase in the length of that side to which the pelvis leans.

The *shape* of parts is frequently a diagnostic sign of change of structure or of function.    The pyriform shape of hydrocele, the oval, globular, or ovoidal form of hernial tumors; the change produced in joints by effusions, the knotted, lobulated tumors of cancers, the protuberant abdomen of ascites, all are points which may be referred to as furnishing valuable aid from their shape in deciding on the existence of these affections.

### ¿ 4.—Of Color.

The *color* of the skin on different parts of the body is a change which is often so marked as to indicate not only to the surgeon, but even to the patieut, the progress of disease.    This variation of color is most valuable as a diagnostic sign, and should be always noted, as in the lividity of bruises, the redness of superficial burns, or in the chocolate tint which is apparent in partial or diffused sphacelus.

When attendant on progressing mortification, the color of the integuments generally changes from the acute redness of healthy inflammation to the livid blue or purple of passive congestion; and then again, when the reparative process is established, and nature begins to separate the dead from the living portions, we can trace the "red liue of demarkation" and see the black of actual death, separated by various shades of blue, black, purple, and chocolate, from the bright scarlet of healthy, active, inflammatory congestion. Extreme caution is, however, necessary in forming a diagnosis of sphacelus from color alone, as a bruise, an effusion of blood beneath the skin, the occurrence of purpura hemorrhagica, the discoloration following the use of leeches, of adhesive plaster near suppurating surfaces, and of washes of iodine, or of the nitrate of silver, all produce such variations in shades as may readily mislead an inexperienced observer.    The color of the skin is also serviceable in diagnosticating tumors, though the lividity and blueness of many of them is simply due to the temporary venous enlargemeut caused by a congestion of the superficial veins.    The change of color here alluded to is one solely dependent on the compression of the vessels by the tumor as it distends the skin, aud is not necessarily connected with the structure of the

tumor itself, simple fibrous and non-malignant growths occasionally produ-
cing lividity in as marked a degree as that seen in those which are more
malignant.   The nævi materni, or mother's mark, aneurisms by anastomosis,
varicose veins, aneurismal tumors—in fact, everything that impedes the free
circulation of the blood through the capillary vessels, may be the cause of
changes of color in the skin over them.

### § 5.—Of Temperature.

The *temperature* of a part or of the entire body, as indicating a change
in the local or general circulation, is always deserving of the surgeon's
attention, though it is not as valuable an indication, when judged of by our
sense of touch, as might be supposed, both patient and surgeon being occa-
sionally deceived by their own impressions.   Thus the burning heat of in-
flammation is often alluded to by patients, and felt by surgeons, as apparently
many degrees above the natural warmth of the body; yet it is well known,
from the oft-reported experiments of Hunter, that it is only a degree, if at
all, above that of the blood, at the centre of the patient's circulation, though
perhaps higher than the natural heat, especially in the extremities of the
part affected.

Cold, or the absence of heat, is often a symptom of much value, because
it is generally indicative of disordered circulation or low powers of life, and
thus shows the presence of danger from the want of vitality.   The tempera-
ture of a part should therefore be always carefully attended to after the liga-
ture of a great vessel; while the coldness of surface, consequent on severe
injuries and operations, demands our greatest care, in order to ward off evil.

### § 6.—Of the Excretions and Secretions.

The surgeon, in the formation of a diagnosis, will gain much knowledge
from inspection of the excretions of the body and the accidental local
discharges.

Thus the *urine*, whether clear, turbid, or high colored; whether mixed with
blood or pus, and with or without sediment, is not unfrequently indicative
of the condition of the kidney or bladder; while the *feces* present points
not only from which to gain a knowledge of general constitutional disturb-
ance, but also of local change of structure.   Blood mixed with the discharge
of fecal matter may be the result of hemorrhoids; pus mixed with it may
show the existence of ulceration; and a contracted, narrow-shaped piece of
feces, or one looking as if compressed, or shaved on the sides, may prove
the existence of an enlarged prostate gland, the development of scirrhous
growth, or the existence of rectal stricture, which would otherwise be
overlooked.

The *sputa* and *matter vomited*, according to their color, consistence, and
substance, are occasionally among the most important of our diagnostic
points in injuries of the throat, lungs, stomach, etc.   If a wound of the
chest is followed by a free expectoration of bloody and frothy mucus, the
lung will probably be found to have been injured; while the hawking of blood
or of pus, and the vomiting of the contents of the stomach, would very truly
indicate the state of the throat or stomach in many surgical affections, while
in wounds of these parts, such matter would prove extremely valuable as
an aid to diagnosis, especially when tested microscopically and chemically.

The continuance of the normal secretions is in some cases the sole indica-
tion of the soundness of parts which could not otherwise be proved.   Thus

a pure mucous expectoration, or the regurgitation of food or drink after an injury of the chest or abdomen, or the natural discharge of bile or of urine after an injury of the liver or bladder, would alone establish the fact that their normal functions were not impaired by the accident.

The character of the discharge from wounds, ulcers, fistulæ, etc. always demands attention, as indicating important points in the pathological condition of the part; thus healthy pus, and the clean moist edges of a sore, generally show a healthy wound or ulcer, or one which is disposed to heal; while unhealthy, sanious, offensive matter, with dry edges and the formation of crusts and scabs, not unfrequently declares the existence of less favorable circumstances.

The character of the *pus* is especially valuable as a diagnostic sign, it being indicative of the true condition of many parts; thus, that which is an opaque, tolerably consistent, yellowish-white fluid, with a peculiar smell when fresh, which it loses on cooling, which is of a sweetish taste, specifically heavier than water, (spec. grav. 1.030,) not readily subject to putrefaction, and which reacts in its fresh state as an alkali, but after a time is neutral or acid, and which is seen under the microscope to consist of fluid parts and globules, is known as good or "laudable pus," and indicates healthy action; while that which is thin, mucus like, serous, grayish, greenish, brownish, and more or less fetid, shows the progress of disease, and is termed "sanies or ichor." Small lumps of cheese-like matter, mixed with pus, usually indicate the existence of the tuberculous or scrofulous diathesis; while fecal matter, blood, and undigested particles of food mixed with pus, often prove clearly a direct communication with the bowels, as in rectal fistula.

## SECTION II.

### EXAMINATION OF THE INTERNAL ORGANS.

After studying the external signs of surgical disorders, an investigation of the condition of the internal organs, as shown by an examination of their functions, will also furnish an amount of knowledge which is in many cases absolutely essential to the formation of a correct diagnosis. In this investigation the student's attention should be directed to four different functions of the economy—1. The Circulation. 2. Respiration. 3. Digestion. 4. Nervous power.

### § 1.—State of the Circulation.

The diagnostic signs furnished by an examination of the general state of the circulation, and indicated by the action of the heart and of the pulse as seen in fevers, are well known even to non-medical men. I shall, therefore, pass at once to such points as mainly demand the attention of him who is engaged in the practice of surgery.

The information furnished by the circulation, independent of its value in connection with the pulse, is mainly useful in showing the existence of injured or diseased vessels, and is best seen in the different kinds of hemorrhages and in arterial tumors. In hemorrhages, the signs from the state of the general and local circulation are all important. The sudden sinking of the pulse, feeble action of the heart, loss of color in the capillaries, all indicate the loss of blood, while its color and mode of flowing have already been alluded to as pointing out wounds of arteries and veins. It should, however, be remembered that it has occasionally happened, that an opening in

a vein which lies directly over a large artery has caused a pulsating stream, similar to that from a wounded artery, in consequence of the action of the vessel beneath it; and that a serious loss of blood has not unfrequently given a red color to the stream flowing from a vein.    It is also useful to note the source of hemorrhages; thus the escape of blood from the ears may show either a rupture of the membrana tympani, especially in very young subjects ; or, what is more common, a fracture at the base of the skull, and particularly of the petrous portion of the temporal bone.    The color of the fluid in the latter case is more frequently that of venous than arterial blood, and its escape through the ear has been explained on the supposition of a rupture of the petrous or other sinuses, which, by detaching the dura mater from that part of the base of the skull, allows the blood to pass through the seat of fracture into the internal ear, whence it flows outwardly through the rup- tured membrana tympani.    But in all hemorrhages, the state of the circula- tion is more important as a prognostic than as a diagnostic sign.    In some cases of severe injury, especially contusions and other affections of the abdo- men, the escape of blood outwardly need not be looked for, the internal flow being the most frequent, and, from being unseen, the most deceptive. Here the loss of color in the capillary circulation, the pallor of the face, the feeble pulse, and other general symptoms of prostration, are alone capable of indicating the internal injury.

In tumors, especially if dependent on aneurismal enlargement of vessels, the activity of the local circulation is strongly indicative of the affection. Still, an enlarged gland, fibrous, fatty, or other tumor, when bound down by fascia upon the course of a main vessel, may prove a source of error, unless close attention is paid to the collateral circumstances.    When it is desirable to ascertain whether a pulsating tumor is aneurismal, or merely an enlarged gland affected by its position in regard to the artery, we should always endeavor to elevate the tumor from the subjacent parts, and then notice whether the pulsation continues.    Pulsating tumors in the ordi- nary position of lymphatic glands, as in the groin, axilla, or neck, should always be thus carefully removed from subjacent parts by the fingers, if pos- sible, before deciding on their true character.    The absence of the peculiar aneurismal thrill, the solidity of the swelling, its gradual development, with the enlargement of neighboring glands, the peculiar constitution of the patient, the exciting cause, etc., will all aid us in determining this important question.

The state of the circulation, as exhibited in the capillary vessels, is import- ant in diagnosticating erectile tumors, fungi, etc., the natural condition of the local circulation before the development of the swelling being always borne in mind.    The character or appearance of the surface itself, in connection with the flow of blood, is also important in the diagnosis of certain disorders; thus, the rupture of skin and the repeated hemorrhages from a swelling, may enable us to distinguish fungus hæmatodes from cancer ; while frequent bleed- ings from mucous cavities, accompanied with swellings or tumors, would lead to the suspicion of polypi or of ulceration.    A suddenly-formed tumor in the neighborhood of a joint, producing discoloration of the skin and faint- ness, supervening on violent muscular exertion, especially if the tumor is seated in the axilla, might lead a surgeon to regard it as the result of a partial rupture of the artery ; while the same swelling, unattended by a depressed state of the circulation, and not gradually increasing, would prob- ably be only indicative of a dislocation.    The feeble pulsation of the arteries in the extremities not unfrequently indicates an obstruction in the course of a vessel or its ossification ; but if it is at the same time accompanied by a change of temperature and color, it would naturally lead to the suspicion of

senile gangrene.   In examining for the pulsation of an artery at its usual
seat, allowance must be made, under these circumstances, for a natural mal-
position of parts, in order to avoid error; thus the brachial artery occasion-
ally divides high up in the axilla, and the femoral sometimes gives off the
profunda very low down, and either might prevent the sensation of pulsation
in the usual points of examination without producing any inconvenience to
the patient.   The radial artery also occasionally winds round the wrist so
high up as to leave no pulse in the ordinary position.   To decide, then, that
there was an interrupted circulation in these cases without an investigation
being made as to the course of the vessel in the individual under examination,
would only prove the want of caution in the observer.

## § 2.—Of the Respiration.

As the rapid or labored state of the respiration is often the result of
increased muscular or vascular action, the notice of its rapidity and char-
acter, as shown simply by inspection, is occasionally a most useful adjuvant
to the formation of a surgical diagnosis.   In congestive affections of the
brain, whether resulting from blows or from the action of poisons, a slow,
snoring, or stertorous respiration should instantly call attention to this im-
portant organ, as such a respiration indicates not only injury, but the import-
ance of relieving the brain from it, before the respiratory action is entirely
interrupted.   Stertorous respiration must not, however, be confounded with
the ordinary snoring of some patients when asleep, nor yet with the peculiar
respiration of those laboring under enlarged tonsils or nasal polypi, or the
breathing of intoxication.

In wounds of the larynx and trachea a marked change will be noted in the
natural sounds of respiration, and in ulceration of the glottis, nasal polypi,
elongated uvula, fissure of the palate, dislocations of the laryngeal cartilages,
as well as in foreign bodies in the trachea or œsophagus, the change in the
tone of the voice, or the peculiar cough, will very often at once enable us to
form an opinion as to the existence of either of these affections.   Especially
is this true in the affections of the nose and mouth, a very slight departure
from the normal condition of either producing a change of sound that leads
the practiced ear at once to recognize the seat of the disease.   If practical
opportunities have not led to a knowledge of the change of voice here
referred to, it is only necessary for the observer to close his own nostrils more
or less with the fingers and then speak, in order to furnish a tolerably correct
illustration.   In such cases the patient speaks, it is said, through the nose,
though perhaps it would be more correct to say he speaks without the nose;
the change of voice being evidently due to the interruption of the passage of
the sound through the nasal cavity, in consequence of which we have the
resonance of a partially closed chamber.   The hacking cough, efforts to clear
the throat, and constant sensation of tickling, are also sufficiently frequent,
as evidences of disease in these parts, to demand an examination of the state
of the uvula and fauces, in all cases of affections of the throat, so that we
may prove the presence or absence of elongation of the uvula, a cause which,
though apparently trifling, is yet sometimes productive of most serious con-
sequences by the extension of the irritation to a pulmonary structure which
may be predisposed to tubercular infiltration.   In examining the respiratory
organs, the surgeon will often require to exercise that knowledge of ausculta-
tion and percussion which is so essential in the practice of medicine in deciding
on the physical condition of the thoracic contents.

### § 3.—Of Digestion.

The changes produced by surgical affections in the ordinary functions of the digestive organs, whether arising from a local or general injury, should always lead to a careful investigation of their separate portions; the acts of mastication, deglutition, and defecation occasionally proving most conclusively the condition of parts to which attention might not otherwise be directed.

**Mastication.**—Mastication, when imperfectly performed, may indicate an injured or diseased state of the teeth or of the muscles of the lower or upper jaw, though most frequently the former.   The existence of caries in the teeth is often first shown by the pain consequent on the act of chewing, and the difficulty of properly approximating the lower to the upper jaw is highly characteristic of certain dislocations and fractures.   A crackling noise in the neighborhood of the ear—often only heard by the patient, but occasionally also evident to the by-stander—indicates disorder in the maxillary articulation, while the escape of saliva, enlarged glands, distortion of tongue, etc., very often result from cancer, ranula, and other lingual and buccal tumors.

**Deglutition.**—Deglutition, as usually performed, is an act that, after mastication, it is almost impossible to prevent under a healthy condition of parts; but let the tonsils be swelled, the uvula enlarged, the tongue affected, or the pharyngeal or œsophageal passage at all inflamed or constricted, and swallowing becomes difficult or even impossible.   When the roof of the mouth or the hard and soft palate are sound, or when the lips present their natural structure, food once introduced into the mouth passes on without trouble; but in hare-lip, or fissure of the hard or soft palate, it is found either difficult to get it into the mouth, as in suckling, or, when there, the food is seen to escape more or less through the cavity of the nostril.   In the healthy condition, food, both solid and liquid, is readily transmitted to the stomach; but in œsophageal stricture, or in the formation of tumors or abscesses in or near the œsophagus, swallowing becomes difficult, while from the accidental course of a particle of food into the larynx, spasms sometimes ensue that are occasionally most serious.

**Hunger and Thirst.**—Hunger and thirst, in the healthy state, are removed by the introduction of food and drink into the system; but let the natural course of the articles be impaired by an injury to the digestive apparatus, and these desires immediately become more persistent.   A recurrence of either hunger or thirst, a short period after food and drink of an ordinary amount have been taken, may, therefore, naturally lead to a suspicion of the escape of the food at some point of the digestive tube before entering fully into the system; hence wounds of the throat or stomach, artificial anus, etc , are not unfrequently followed by constant hunger.

**Vomiting.**—Vomiting, as a symptom of surgical disorders, is often an important aid in the diagnosis and prognosis of an injury.   In concussion of the brain and in blows upon the head, especially in the young, vomiting may generally be regarded as indicative of serious cerebral disturbance; and when followed by a tendency to sleep, or by stertorous respiration, should always render the prognosis of cerebral injuries most guarded.   Occasionally it happens that a slight blow upon the head soon after a meal is followed by copious vomiting; but, under these circumstances, this act should not be regarded in as serious a light as when following an injury at a considerable interval after eating.   If the vomiting is laborious, and there is reason to suspect effusion, or even a tendency to the rupture of a vessel

in the brain, the act of vomiting should be facilitated by the free use of warm diluent drinks, until the stomach is emptied, when, if possible, it should be arrested by the administration of aromatics or *mild tonics*.

The matter vomited is also not unfrequently highly characteristic of the injury or disorder. Vomiting of blood may arise from a wound of the stomach or throat, or it may simply follow a severe epistaxis in which the blood has been swallowed. Strangulated hernia, especially after a few hours duration, often causes the vomiting of stercoraceous matter, and in intussusception, stricture of the bowels, etc., the same kind of matter is often more or less mixed with the ordinary contents of the stomach.

**Hiccough.**—Hiccough may be the consequence of a wound of the diaphragm, or of irritation of the phrenic nerve, though it is also noted as the result of long-continued vomiting, or as the consequence of extreme nervous or vascular prostration.

**Of Defecation.**—Defecation is indicative, in many instances, of the actual condition of the lower bowels. Hardened lumps, or "scybalæ," indicate constipation, no matter what it may be dependent on; while the mixture of pus or blood will sometimes lead to the suspicion of an abscess opening into the bowels, to the existence of fistula or hemorrhoids, or to the development of cancer. In the natural condition of the rectum the feces are usually round and of moderate size; but in stricture of this gut, or in an enlarged prostate gland, the stool is most generally flattened on one side, very much reduced in size, and occasionally appears as if shaved by a cutting instrument. The microscope and chemical tests may often also be the means of showing the changes existing in the digestive organs, as illustrated in the constituents of the fecal discharges seen in cholera, the rice-like matter being epithelium removed from the mucous coat of the intestines.

### ¿ 4.—Of the Functions of the Nervous System.

When we recall the importance of the brain and spinal marrow, in the ordinary functions of man in a state of health, we must at once admit the value of the signs furnished by the nervous system in cases of injury; and were we fully acquainted with the connection of parts, and that mutual relation to each other usually designated by the vague term "sympathy," we doubtless should find most valuable indications from the study of its derangements. But, as a general rule, the changes of function in the nervous apparatus furnish but a negative sort of evidence to the surgeon.

The sensations of the patient, the existence or absence of pain, his descriptions of the accident, or the loss or exaltation of muscular power, may all be dependent on serious injury of the nervous centres, or simply the result of a certain activity of imagination. In some patients the normal sensibility will be highly augmented or diminished, nausea and faintness be present or absent, and the whole system either depressed or highly excited, without any serious lesion existing to explain this departure from the natural condition. The value of the signs furnished by the nervous system depends, then, in a great degree, upon the skill of the examiner in developing their existence, and upon his caution in guarding against deception on the part of the patient. To some persons—owing to peculiar mental action—a trifling injury is shocking in the extreme, and accompanied by great prostration, while others who labor under very serious lesions will yet retain their composure, sensation, power of movement, and mental and bodily strength. We have seen more than one strong adult rendered faint, with a feeble pulse, cold skin, pallid face, and showing every sign of great apparent prostration

when simply *ordered* to be bled; while others have undergone horrible lacerations by machinery, etc., and yet retained much of their usual mental and sensorial powers.

But, as a general rule, loss of muscular power, loss of sensibility, or the extreme development of either, should be regarded as indicative of cerebral or spinal disturbance.

The symptoms of prostration, characterized as the "Shock of Injury," will be detailed hereafter.

## SECTION III.

### METHODICAL USE OF THE SENSES IN FORMING A DIAGNOSIS.

Presuming that the surgical observer, being aware of the dangers in his path, is mentally prepared for a close observance of facts, we may now study the impressions produced on the mind by the use of the senses, arranging them according to their actual value in the investigation of disease, thus: 1. Sight; 2. Touch; 3. Hearing; 4. Taste; and 5. Smell; the facts thus learned being afterward mentally digested before a conclusion is formed.

By thus methodically exercising his ordinary means of acquiring knowledge, little will be overlooked in the investigation of disease by a careful observer; while the more confident and less systematic practitioner is very liable to fail in noticing some point, and thus makes an erroneous observation.

### ¿ 1 —Of the Sight.

So generally useful is the sight as a means of diagnosis, and so constant is its employment, that, without a careful analysis of the facts furnished by it, most persons would probably overlook the sources through which they gain their information and credit other senses. With the exception of touch, the sight is the most accurate of a surgeon's senses, especially if properly cultivated; but, before relying on its impression in disease, he must be familiar with the appearance of healthy structure, as well as with the general natural contour of the body.

In examining the *form* of a part by the sense of sight, a comparison of the unnatural appearance with that presented in health must necessarily be made before any value can be assigned to the point of deviation that is noted. In the shortening of the limbs in fractures; in the deformities from dislocations; in the swellings caused by tumors and suppurations, and even in the contraction of natural orifices, little can be learned unless the surgeon is capable of recognizing the degree of departure from a state of health.

After judging of change of form, he should next decide on the variations in the *color* of the parts. Increased redness may show the commencement of inflammation; the red line which tends toward the chest may indicate its progress in the course of a lymphatic; linear or circular redness, the efforts of nature to separate mortified parts from those which are sound; a copper-colored spot, the probability of syphilitic taint; and a bluish-red color will often indicate venous rather than arterial vascularity, chronic inflammation, erysipelatous disorder, or the formation of abscesses; while a more livid tint is often characteristic of ecchymosis from contusions, or, when vesicated, indicative of commencing gangrene. A yellow modification of these two tints may generally be correctly associated with hepatic disorder; but, though the change of color often shows the existence of disorder, it does not invariably do so. Many tumors, in their earlier stages, simply elevate

the integuments without producing a change of color, as is seen in fatty as well as in aneurismal tumors, cold abscesses, hernia, etc., although, subse-quently, the approach of these tumors to the surface of the part modifies more or less its previous condition, both in shape and color.

By the sight we also judge of *change of structure*. Thus, in wounds, we can tell their character by their edges, and their depth by the color of the blood escaping from them, or the presence of muscular tendinous fibre, or by the display of nerves. In ulcers, we judge of their acuteness and duration by the aspect of the granulations and the character of the discharges; while from the vascularity and adherence of cicatrices we may form an opinion of the nature of the deep-seated parts, as in the peculiar color and attachment of cicatrices over bones. In all these instances, the sight, or a mere inspec-tion, will enable an educated observer to detect at a glance the character of the complaint, and to decide, by so rapid a comparison of parts, that the latter process is almost lost sight of, his opinion seeming to be formed intuitively.

By the sight we also judge of the character and contents of tumors; thus, some are smooth and even on the surface, others are nodulated or lobulated; some are pendulous, some pulsate, some are evidently turgid with blood, some pale and shriveled; all which differences indicate variations in condi-tion, the details of which are to be subsequently learned by the employment of other means and senses.

The use of the sense of sight, as a means of diagnosis, has in recent times received valuable assistance from the **Microscope**, which has been applied to the study of morbid tissues and secretions. In the first enthusiasm of a new pursuit, extravagant hopes were entertained, by microscopists, of the value of the microscope as an aid to diagnosis, which have not been entirely realized; hence the way was paved for a revulsion of feeling which has led some to reject this instrument in diagnosis. The truth, as ever, lies between the two extremes, and it may now be regarded as well established that, without any pretensions to infallibility or to the capability of solving every doubtful case, the microscope may be regarded as a valuable aid to the sense of sight in the formation of a diagnosis, especially in calculous diseases and affec-tions of the bladder, by the examination of the several urinary deposits, as well as in the sputa, vomited matters, puruloid discharges, and of many other morbid products. A marked diversity of opinion, however, exists as to its usefulness in the diagnosis of *tumors*, and especially in diagnosticating cancerous from innocent tumors, with a view to the prognosis of the cure of these growths by operation, though the sentiment is becoming more general that, in skillful hands, the microscope is a valuable adjunct to other means of forming an opinion in such cases. The structural appearances, upon which a diagnosis of the several morbid growths is to be based, will be found de-tailed hereafter in connection with each.

Microscopical observation, to be of value in diagnosis, must be made by a competent person, and with a good instrument. The observer must be familiar with the use of the apparatus he employs, and must have mastered the normal appearance of the several tissues, before he presumes to judge of the nature of the morbid processes of which they may be the seat. The beginner is here, as in other cases, apt to be beset by many sources of fal-lacy. Among these may be mentioned those which arise from the presence, in the portions examined, of various extraneous matters, such as air-bubbles, fragments of human and other hair, of scraps of cotton or worsted threads, portions of feathers, starch granules, and many similar bodies, which occa-sionally find their way, in spite of all precaution, into the most carefully-made preparations.

In selecting an instrument for daily use, the highest degree of optical and mechanical perfection attainable is not absolutely necessary, but the object-glasses should be good, and the mechanical parts sufficiently well made to be firm and free from tremor.

The *stand* should be moderately heavy, capable of inclining to accommodate the observer when in the sitting posture, or of being used in the perpendicular position. It should be furnished with a coarse and fine adjustment for regulating the focus, which should be so finished that when used they shall not communicate any lateral motion to the field of view. The stage should be provided with a revolving diaphragm plate for regulating the amount of light. Beneath the stage there should be a plane as well as a concave mirror, the first for the lower, while the latter will be found useful for the higher powers.

The *eye-piece* should be one of feeble magnifying power, or, if several are obtained, at least one of them should be so. It is a great error, and one into which beginners are very apt to fall, to suppose a highly magnifying eye-piece of any advantage for practical purposes, the loss of light and definition resulting from its employment more than counterbalancing the advantages of the increased size of the object.

Two *object-glasses* are amply sufficient for most of the purposes of the student, the inch and the quarter inch, though to these the observer must add, for the satisfactory study of tubercle and certain tumors, an eighth of an inch.

The object-glass of one-inch focal length should magnify with the low eye-piece from 30 to 50 diameters linear. It will also prove convenient to have this glass so made that the lower lens can be removed and a feebler power of 15–25 diameters thus obtained. This glass will be found useful in the study of the larger urinary crystals; of preparations in which the blood-vessels have been injected with coloring matter; of thin sections of tumors, etc., for the purpose of determining the arrangement of the elements and the relations of the several parts.

The *object-glass of one-quarter inch* focal length ought to magnify with the low eye-piece about 200–250 diameters; objects seen through it should be equally visible in all parts of the field, and appear well defined and free from colored fringes. This glass must not be difficult to illuminate satisfactorily by ordinary daylight. It should be arranged so as to permit the study of preparations covered with a thin glass cover, ($\frac{1}{700}$ of an inch thick,) the more costly variety which permits the glass to be corrected for covered or uncovered specimens each time that it is used not being requisite for the purposes of the student. With this glass the smaller urinary crystals, blood, pus, sputa, the elements of the several tumors, etc. etc. may be studied.

The *object-glass of one-eighth of an inch* focal length, magnifying about 400–450 diameters with the low eye-piece, may be used for the same purposes as the quarter inch, whenever, from the minuteness of the object studied, the quarter appears inadequate to satisfactorily observe its details. It can, however be dispensed with in the majority of cases, and the student had better be provided with a quarter inch of *good* quality than with a poor quarter and eighth.

Besides the above pieces, the microscope should be provided with a bull's-eye condenser, to view opaque objects; with a camera lucida, to draw objects; and a micrometer, to measure them.

For a detailed account of the method of using the microscope for diagnostic purposes, the reader is referred to the numerous microscopical treatises now published, and especially to the two excellent works by Dr. Beale, of

London, "How to Work with the Microscope,"* and "The Microscope in its Application to Practical Medicine."†

## § 2.—Of the Touch.

Surgical disorders being defined as "such as are more or less tangible," the sense of touch is evidently one of the most important as well as the most generally applicable of all the means adapted to their diagnosis. Many conditions of disordered action are appreciable mainly through the use of this sense, such as the mobility of tumors; the movement of liquids, as in fluctuation; the pulsations of aneurisms; the crepitation of emphysema, of tendons, and of fractured bones. The sensitiveness of the patient, as developed by the pressure of the surgeon's fingers, is also an example of the aid given by the touch, in the formation of a diagnosis, as when it shows the position of the testicle in hydrocele. In fact, without the sense of touch, it would often be impossible to make a diagnosis of surgical complaints.

In exercising this sense, the fingers may require the intervention of instruments, in order to reach the object to be touched, as in sounding for stone in the bladder, where the presence of the stone is made sensible to the finger only through the medium of the steel instrument.

The **Touch** may be practiced in surgery either through the direct contact of the fingers or of the palms of the hand. In using the fingers, without the intervention of a foreign substance, it will be found that the forefinger is that which is most sensitive as well as convenient, though the apposition of the second to the first finger, by augmenting the tactile surface, often adds to the accuracy of the impression. With the two fingers thus placed, or with the index finger of each hand alternately pressed perpendicularly on the surface of a swelling, the superficial parts may be made gently to approach the deeper structures; and if any of their contents are fluid, the movement of a liquid or "fluctuation" may be certainly recognized; or, in the case of larger collections of fluid, as in abdominal dropsies, the apposition of the entire palm of one hand on one side of the belly, while the opposite side is lightly tapped with the pulps of all the fingers of the other, will often indicate the presence of liquid by the sensation caused by the succussion or concussion of the wave thus created against the palm as at first placed. In practicing "the touch," in order to prove the presence of liquid, caution is, however, necessary, lest the sensation caused by the movement of a flaccid tissue, as a relaxed muscle, be mistaken for the motion of liquid.

Few points of diagnosis present greater chances of error on the part of a young surgeon than this false sense of fluctuation. In order to avoid it, he should therefore proceed as follows: Retain the fingers of one hand with sufficient firmness on one side of the part to be examined, while with the other he presses quickly and with moderate force on the opposite side of the swelling; or, if the part to be examined is of considerable extent—as the abdomen—let him direct an assistant, as advised by Recamier, to press gently with one hand in the median line of the body, while he manipulates with his own hands, as just stated. The motion of the intestines, as well as of the liquid wave, being thus partially checked, the sense of fluctuation, if yet apparent, will be almost certain evidence of the presence of liquid.

* "How to Work with the Microscope," by Lionel Beale, M.B., F.R.S. London: John Churchill.

† "The Microscope in its Application to Practical Medicine," by Lionel Beale, M.B., F.R.S. 2d edition. London: John Churchill, 1858.

By the rapid pressure of the finger upon an inflamed part, and its equally prompt removal, the surgeon is also often enabled to judge of the existence of congestion in the superficial vessels, or of the activity of the capillary circulation.    If the skin becomes momentarily pale under pressure, and then quickly resumes its livid or florid color, there can be no doubt of the rapid flow of blood through these small vessels, which, being emptied by pressure, and thus rendered pale, become so turgid in a moment as to restore the original color of the part.

Soft and elastic tumors, containing a thick or jelly-like structure, often present an indistinct sense of fluctuation, (as in cases of fungoid disease,) in consequence of the yielding of the structure under pressure, and its rapid enlargement by the afflux of blood, which instantly supervenes on the removal of the pressure.    Under these circumstances, the liability to error from the use of the sense of touch is very great ; so much so, as occasionally to require the addition of a minute puncture with an "exploring needle," in order to correct the impression by disproving the presence of a liquid.    The best method of avoiding error under such circumstances, without resorting to the use of the needle—which may become a focus of irritation—is to retain the finger in position, as just stated in the case of a relaxed tissue ; that is, to press firmly with the fingers on one side of the tumor, and then tap quickly and with some little force on its opposite side.    Unless liquid is present, the succussion will not be felt, the thick character of the contents preventing the transmission of the blow of the finger to those first placed on the tumor.

The peculiar sensation of rubbing or "crepitation," caused by the friction of the surfaces of two fragments of bone, or by the play of two articulating surfaces of a joint upon each other, or by that of a tendon in a thickened bursa, or in effused lymph, is also recognized mainly by the sense of touch, though that of hearing may be made to aid it under certain circumstances, as will be again mentioned in connection with the subject of fractures.

The degree of motion in a part, whether due to the existence of fracture or dislocation, the development and attachments of tumors, or their connection with the blood-vessels, is also recognizable chiefly by the sense of touch. In investigating the presence of pulsation in tumors, the fact previously alluded to must be remembered, to wit, that vascular pulsation is sometimes caused, not by disease of the artery, as in cases of aneurism, but simply by the proximity of a tumor to the vessel, the pulsation of which is felt in the tumor, in consequence of the latter being either directly in contact with it, or bound down upon it by adjacent fascia.    To avoid this error, the surgeon should endeavor to remove the tumor as much as possible from the vicinity of the artery, by lifting it up from the deeper-seated parts, or give the parts such a position as will relax the fascia and muscles.    Under such manipulation, the sense of pulsation will often be entirely destroyed, and the diagnosis rendered more certain.

The various errors of diagnosis made by able surgeons under these circumstances sufficiently prove the great necessity of caution in similar cases. Thus M. Bérard, in an excellent thesis "on diagnosis," cites many instances ; in one, a large abscess above the clavicle pulsated so strongly, and otherwise so closely simulated an aneurism, that the operation for ligating the artery was proposed by the surgeon, and only avoided by the determination of the patient to commit suicide.    To accomplish this he punctured the tumor, when the exit of pus established the character of the complaint.    The same author also cites a case of fungus of the dura mater, which was mistaken for aneurism of the temporal artery ; and one of goitre, which was mistaken for aneurism of the carotid.    The recorded errors of diagnosis arising from the false impressions produced by the sense of touch are so numerous as to pre-

vent anything like a full enumeration of them at present, and the caution in regard to them must therefore be thus briefly alluded to, and again given in connection with special cases.

### ¿ 3.—Of the Hearing.

By the sense of hearing, the surgeon often acquires such a knowledge of the disordered action or condition of a part of his patient's organism as is specially useful to him in the formation of an opinion respecting the nature of the complaint.

By the variations in the *tone* of a patient's voice he is enabled to judge of changes in the condition of his nasal passages, as may be noticed in cases of polypi narium ; of fissure of the hard and soft palate; disorders of the larynx and trachea, etc. ; the details of which will be given hereafter in their appropriate place.

By the sound of "*gurgling*" he recognizes the presence of gas or liquid, and thus obtains one proof of the existence of a hernia, or of a collection of liquid in a circumscribed cavity ; while in operations near large veins, he also by this sound is apprised of the entrance of air into the vein, and of the liability of the patient to sudden death.    By the crackling sound designated as "crepitus," he learns the condition of certain structures as modified by disease or accident; thus, when gas collects in the subcutaneous cellular tissue as the result of mortification, its passage through the cells may be heard to crackle, as well as be felt; when two fragments of a broken bone are rubbed together, the crepitus may be heard, while the crepitation is felt; in the infiltration of the skin from wounds near the organs of respiration, the crackling of the emphysematous condition may also sometimes be heard as well as felt ; and in wounds of the lung, the escape of the air into or from the cavity of the chest may also be distinctly heard, thus constituting evidence of the character of an injury which could not otherwise be positively recognized.

The true state of many structures involved in tumors is also often learned chiefly through the employment of the sense of hearing, as in varicose aneurisms, where the peculiar "*whir*," caused by the current of the circulation, proves the connection of a vein with an artery.    The crackling of the osseous shells of certain bony tumors, and the elastic " ripe watermelon-like sound" produced by percussing encephaloid growths when connected with bone, is often a valuable aid to the knowledge of their true character.

Percussion and auscultation, which by the genius of Laennec have been made so useful to the physician, are also not less valuable to the surgeon. The viability of the fœtus in utero, prior to the performance of the Cæsarean section ; the extent and condition of abdominal tumors ; the extent of effusions into the chest, and the propriety of the operation of paracentesis thoracis, are but a few of the instances in which the surgeon is aided by the employment of these adjuvants to diagnosis.    The addition of the *sounding-board* to the vesical sound enables us to recognize by auscultation and percussion the presence of a stone in the bladder.    Percussion will often indicate the extent and character of abdominal tumors, the distended state of the bladder, the presence of the uterus, etc.

## § 4.—Of the Taste.

It is not often that the surgeon of the present day feels the necessity of calling the sense of taste to his aid in forming a diagnosis; but the older surgeons tell us that laudable pus has a sweetish, mawkish taste; that a gangrenous part gives a very sharp taste, as Valsalva is said to have proved; or that the fluid which escaped from an abdominal fistula was bile or urine, as is reported to have been proved by Petit's tasting the discharge. Though under such circumstances professional zeal may carry a strong stomach safely through such an experiment, few would at the present day, with the aids now obtainable from the microscope and chemical tests, be disposed to repeat it.

## § 5.—Of the Smell.

From the superficial character of many surgical disorders, the odor created under various changes of structures by disease often brings this sense into play, to the very great inconvenience of the young surgeon.   The peculiar and often disagreeable odors created by certain conditions have, however, a value in diagnosis.   Thus it is easy to tell a vesico-vaginal or a perineal fistula by the ammoniacal odor of urine; and to recognize the fact that an anal fistula communicates or is in close contact with the rectum by the fecal odor of its pus; that a hernia is strangulated by the fecal odor of the matter vomited; while the odor of gangrene, or of the pus connected with a necrosed or carious bone, or that from the sloughing of cancerous structures, is so peculiar that when once perceived it is seldom forgotten.

The odor of ozæna and of salivation from mercury is also so marked as to be highly characteristic of the state of the parts which generally produce it.

## § 6.—Defects of the Senses, or Errors of Diagnosis.

As showing the difficulties sometimes attendant on the correct diagnosis of surgical disorders, even by experienced surgeons, and by those who, to guard against error, pursued systematically the method of examination just detailed, it may be stated, as well known facts, that Boyer and Deschamps both mistook a thickened tunica vaginalis testis for a sarcocele, and removed by castration a sound testicle; that Ferrand, when chief surgeon of the Hôtel-Dieu, plunged his bistoury into an axillary aneurism which he mistook for an abscess, and killed the patient; that Dupuytren made the same mistake in an abscess of the pectoral region; that Roux performed lithotomy to remove a calculus which did not exist, though its presence had been previously regarded as certain; while certificates of disease, etc. have not unfrequently been obtained from army and navy surgeons, and men discharged from the service, whose disorders were entirely feigned.   Since the introduction of anæsthetics these and other errors of diagnosis are not so readily made, as the patient, while in a state of anæsthesia, can be much more thoroughly examined than was formerly the case; the contraction of muscles, the screams and noise, and restlessness of the patient being entirely removed by the use of this valuable agent of the nineteenth century. (See *Bérard sur le Diagnostique.*)

# CHAPTER III.

OF the varied remedies demanded in the treatment of surgical disorders, some have a special or limited application, while others are of a more general character. Among the latter may be enumerated the various dressings and bandages employed for the relief of injuries—a class of remedies the use and application of which are generally studied under the head of Minor Surgery, in contradistinction to an operative treatment of a more serious character. They will be here presented as a portion of Surgical Therapeutics.

## SECTION I.

### MINOR SURGERY.

#### § 1.—Dressings.

Although very varied information and skill are necessary for the proper treatment of surgical injuries, and especially those requiring the performance of operations, yet will the success likely to ensue depend in a great degree upon the attention subsequently given to the case. The art of dressing becomes, therefore, a subject of equal importance with that of operating, and should be regarded as a matter of vital consequence, as without it other means will often prove unavailing.

The object of all dressings being the relief of injured parts, their application must of course depend upon circumstances. As a general rule, dressings are intended to preserve injured parts in proper coaptation; unite them, or prevent their too hasty union; shelter them from the action of the atmosphere, or of external injuries; absorb discharges; prevent desiccation of surface; and last, though not least, insure cleanliness. **Dressings** may, therefore, be defined as those portions of different substances applied with such intentions directly to operated or injured surfaces.

The different articles employed, and the means by which they are to be applied, are known under the general head of **Apparatus of Dressing**. This consists of two parts: one containing the *Instruments for Dressing;* the other, the *Pieces of Dressing* to be applied.

The **Instruments for Dressing** must vary according to the nature of the injury, but usually they may be limited to such as are generally found in that assemblage which is furnished by the cutlers, and known as a Pocket Case. This, if required for general use, should contain Dressing or Ring Forceps; Simple Forceps; Scissors, both straight and curved; Probes; Directors; Spatulæ; Bistouries; Abscess Lancets; one male and female Catheter; a Porte-caustic; a Tenaculum; straight and curved

Needles; Ligatures; and often such others as the taste of the cutler or his interests may lead him to select. Under this head, also, the surgeon should, in serious cases, include Razors, Basins, Sponges, Towels, Buckets, etc.; in fact, all that is requisite for the preparing of a part for the application of a dressing, or the removal of the previous one.

As the proper use of the instruments just referred to is not always known by those purchasing them, a brief description of the objects and method of handling each may not be out of place.

The **Dressing Forceps** are employed for removing the different pieces of dressing, not only in order to protect the fingers of the surgeon from discharges that are often very irritating, but also on account of their enabling him to seize them with less risk of injury to surrounding parts, especially by pressure. In cases of fistulæ or sinuses, they are also often necessary, in order to cleanse the bottom of the sinus, or remove deep-seated portions of dressings, or other foreign matter. In using them, the thumb and second finger are to be passed through the rings of the handle, and the forefinger extended toward the joint of the blades, in order to render them more firm.

The **Simple** or **Dissecting Forceps** may be frequently substituted for the Dressing Forceps, especially where minute portions of dressing, such as ligatures, etc. are to be removed. These are, however, more frequently used for seizing such portions of integument as may require to be cut off by the knife or scissors. As similar forceps are employed by each student in dissection, no information need be here given as to the manner of using them.

The **Straight Scissors** are employed in dressing, for the ordinary purposes of scissors; but those which are **Curved**, either on the side or front, are mainly required to facilitate the removal of such dressings as adhere closely to the body; as adhesive strips, bandages, etc., especially where it is desirable to remove them without deranging the position of the part. Scissors are also occasionally used for excision of portions of integuments, as in hare-lip; but they do not answer as well as the scalped for such operations, because they are apt to bruise the edges of the part divided, and thus interfere with its subsequent adhesion. If scissors have a rough edge and cut harshly, light pressure of the thick skin of the thumb along the blades will remove it.

**Probes** are intended as substitutes for the fingers where the space to be examined is too narrow to admit a larger body. But where it is possible to introduce the finger it should always be preferred, on account of the greater accuracy of the touch. The probe should always be made of silver, or some equally flexible metal, in order that it may be readily bent, to suit the position of the part to be examined.

The **Director** is a broad probe with a groove in it, which is generally used to direct the point of a scalpel or bistoury, in the division of deep-seated parts, especially where important organs are in the neighorhood of the incision. Sometimes it is formed with a flat end for a handle, and sometimes it has a ring or other slight expansion to keep it from turning in the fingers of the operator. When the director is required to facilitate incisions, it should be held with the thumb on the top of the handle, and the fingers of the same hand beneath its shaft, in order to prevent its slipping out of place. The knife being held in the opposite hand, is then made to pass along the groove as far as may be desired.

The **Spatula** requires but little description. It may be used either in spreading cerates, in the preparation of dressings, etc., or for removing such portions of similiar substances as remain adherent to the skin.

**Bistouries** and **Scalpels** are of various shapes, and should be selected

mainly with reference to the probable wants of the practitioner. As their use varies much in the different operations to which they are applicable, they will be subsequently alluded to in connection with the subject of Incisions.

**Abscess Lancets** resemble the ordinary thumb lancets, except that they are larger. The manner of using them will be referred to under the head of Operations.

The **Porte-caustic** or **Caustic Holder** is employed as its name designates. It is usually armed with the nitrate of silver, or lunar caustic, and not with the caustic potash. As a general rule, the holder should be made of silver, with platina ends, as this metal is not acted upon by the caustic, whereas bone or similar substances, of which it is sometimes formed, are soon destroyed. When it is desirable in arming the holder to give the caustic a fine point, so as to enable us to touch only small spots, as in the treatment of ulcerated cornea, chancre, etc., it will be best accomplished by rubbing the caustic with a piece of wet rag, so as to wear it away, rather than by scraping, as the brittleness of the nitrate of silver renders it difficult to bring it to a point merely by the use of the knife.

The **Straight** and **Curved Needles, Tenacula, Ligatures,** etc. will be treated of under another head, while the other instruments of dressing, as **Razors,** etc., are so simple as only to require the mere mention of them in order to guard against their omission in the Apparatus of Dressing.

The pieces of dressing are Lint, Charpie, Cotton, Tow, Spread Cerate, or other ointments, Compresses, Maltese Cross, Shields for Amputations, Adhesive Strips, Setons, Poultices, Plasters, and means of Irrigation.

**Lint** is a soft, delicate tissue or mass, prepared in two ways, in one of which the transverse threads of soft new linen are drawn out by a machine, leaving the longitudinal ones covered by a sort of tomentum or cotton-like mass; while, in the other, the cotton-like surface is produced by scraping with a sharp knife a similar piece of cloth previously fastened to some firm substance, Fig. 1. The first is known as the **Patent Lint,** and may be obtained of any druggist, being now generally manufactured. The second is the **domestic lint,**

Fig. 1.



and may be made at a moment's notice when the first is not convenient. They are both employed as primary dressings, either spread with ointments, or alone.
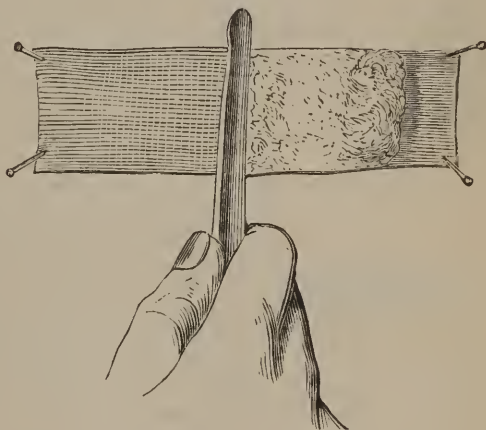
**Charpie** is a substance much employed by the French surgeons, and now gaining a more general application in the United States. It is made by collecting the threads torn from pieces of linen, four or five inches square, such as is used for patent lint. The process, however, goes a step farther than that for making lint, and tears the threads entirely apart instead of preserving the cloth. The linen from which it is made should always be new, and not worn-out table-cloths, etc., as sometimes employed—Gerdy

having proved that when charpie is made from new linen it absorbs better than when from old.  Charpie is usually divided into two kinds, according to the length and fineness of the thread composing it: that which is long and coarse being employed to keep open sinuses or fistulæ, and to act as an outer dressing; while the softer, finer kind is placed in immediate contact with the part, especially where the surface requires stimulation.

Various names are given to charpie, according to the mode in which its fibres are arranged previously to its application.  Thus, we have the Pledget, Roll, Tent, Mesh, Bullet, Tampon, Pellet, etc., each of which has its peculiar advantages.

Fig. 2.



The **Pledget** is a mass of charpie formed by collecting the threads and laying them parallel to each other, with the ends folded underneath.  This being flattened between the palms of the hands, may be made of an oval, spheroidal, or square shape, according to the nature of the part on which it is to be applied.  As thus formed, the pledget is usually spread with cerate, and neatly adapted to the parts it is to cover, care being taken not to make it so thick as to overload and heat the surface of the wound, nor yet so thin as to admit of the pledget becoming quickly saturated with pus.  Where charpie cannot be obtained, the patent lint, cotton, or tow similarly arranged, may be substituted.

Fig. 3.



The **Roll** is a smaller mass of charpie, formed by rolling its fibres longitudinally between the hands, so as to make an oblong mass, which is then tied firmly in the middle, Fig. 3, in order that when the ends are brought in contact laterally, it may form a sort of cone.  It serves for absorbing pus in deep wounds where there is a tendency in the edges to close before the bottom has filled up.  It is also useful in arresting hemorrhages from deep-seated vessels, pressure being made by forcing the central part upon the vessel so that the loose tissue made by the ends may assist in the formation of the clot.  A director, probe, or dressing forceps is necessary in order to carry this into deep wounds or upon a vessel.

The **Tent** is a conical or cylindrical mass of charpie, formed like the roll,

Fig. 4.



except that instead of applying a string to the middle, it is there simply doubled on itself, the loose ends being twisted by the fingers, so as to give it a spiral form and make the apex of a cone, of which the base is the part where the fibres are doubled on themselves, Fig. 4.  This is also employed to dilate fistulous canals, where the orifices are too small to allow of the free escape of pus, and where only moderate dilatation is required.  But where parts are rigid, the sponge tent, or that made by slicing gentian, carrot, or some other porous root into the shape of a cone, or plug, will be found to answer better, as it expands more powerfully.

The **Sponge Tent** is the one most generally employed for this purpose, and answers best in the majority of cases.  It is prepared by soaking common sponge in melted beeswax; allowing it to cool and harden while under moderate pressure, and then slicing it into small pieces, of such a size as will nearly fill the orifice to be dilated.  The heat of the part softens the wax; the sponge fills with the fluids of the tissues, and gradually dilates them to the size required; after which a new and larger morsel must be introduced.  Dry, compressed sponge, made by long and firm pressure, as suggested by Dr. Batchelder, of New York, also makes a good tent or dilator.  In

preparing this sponge, it should be compressed in a vice for a few hours, when it will be ready for use.

The **Mesh** is formed of the threads of charpie, placed parallel with each other and then bent on themselves. It is

Fig. 5.



of great value in the treatment of deep fistulæ, especially fistula in ano. When thus employed it should be anointed with cerate and introduced into the cavity on the point of a probe, Fig. 5, until it nearly touches the bottom. It acts by preventing the edges from healing, thus causing the cavity to granulate from the deepest portion to the surface.

Fig. 6.
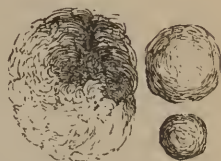


**Bullets** are little balls made by rolling charpie between the hands until it acquires this form. Fig 6. They are extremely porous, absorbent, and useful in filling up purulent cavities, where they prevent matter from burrowing.

When a number of bullets are placed together at the bottom of any cavity, either with a view of distending it or of arresting hemorrhage, they take the name **Tampon.** They are often thus used in gonorrhœal inflammations of the vagina; in fluor albus; and to arrest uterine hemorrhage. For the latter purpose, especially if the hemorrhage follows an operation, or a laceration of the neck of the womb, they may be made of the Boletus Igniarius, or Puff-ball.

The **Pellet** is a large bullet surrounded by a piece of soft rag, the edges of which are brought together and tied firmly, Fig. 7. It is occasionally employed in the treatment of hernia, especially the umbilical hernia of children, where, when bound down by adhesive strips, or a bandage, it answers very well the purposes of a truss. It is also useful in the compression of large vessels, as in wounds of the axillary artery; in the reduction of dislocations into the axilla, and in hemorrhage from parts in the neighborhood of the rectum, being there confined under a T-bandage.

Fig. 7.



In the hemorrhage which sometimes follows the extraction of a tooth, a very useful pellet may be formed, by cutting a bottle cork into a cone and forcing it into the socket with a little lint, simply by closing the jaws.

For the convenience of those who may desire to obtain charpie in this country, I would state that it can now be obtained from druggists generally, of an excellent quality, at very little more than the cost of patent lint.

**Cotton** and **Tow** are substances which are too well known to require a description. Both are of comparatively limited utility as surgical dressings, their places being usually supplied by charpie. Before, however, the application of either of them to surgical purposes, they should be well picked or carded, to free them from foreign matter. The chief use of cotton is as a dressing to superficial burns, where it is useful by protecting them from the air, absorbing the discharges, and forming a sort of scab under which the skin readily heals. When intended to be thus used, it is, however, especially necessary to see that it is free even from *specks*, as the fly is exceedingly apt to lay its egg in it, and this being vivified by the heat of the body, generates maggots, to the great annoyance of the patient and the astonishment of all around him, who, under the belief that he is "eaten of worms," usually regard it as a fatal sign.

**Tow** is employed chiefly as an outer dressing to stumps which are discharging freely, in order to protect the bed. Care is requisite in forming

the Pledget of Tow for this purpose, that it be not too thick and heating, as union is often thus prevented. But the advantages to be derived from the use of Tow under any circumstances may, I think, be doubted, stumps having in very many instances done better with irrigation than when dressed in the old style. Since the introduction of oiled silk, caoutchouc cloth, etc., a bed can readily be protected from dampness, while the evidence in favor of the water-dressing in the treatment of amputations is daily accumulating. With the use of collodion instead of adhesive plaster, and the water-dressing instead of grease and tow, the treatment of stumps is less inflammatory than formerly, and results in better surfaces.

**Compresses** are pieces of linen of various sizes, used to make pressure, confine dressings, prevent external injuries, and equalize the surface of limbs, in order better to adapt them to the application of the bandage, or the compression of the soft parts. Compresses should be made of some soft substance, as flannel, muslin, calico, etc., and with one or two exceptions applied over other dressings. When intended as a direct application to wounds they should always be made of soft linen or lint.

Compresses have received various names, according to the way in which the cloth is folded, or the indications to be fulfilled; thus we

Fig. 8.



have the Square, Oblong, Triangular, and Cribriform Compress, the Maltese Cross, the half Maltese Cross, the Single and Double Split Compress, as well as the Perforated, Graduated, and Pyramidal Compresses.

The **Square Compress** is that in which the substance used has the same dimensions in its two principal diameters. When the square is folded so that it is twice as long as it is broad when doubled in its length, it constitutes the **Oblong Compress**, or Band, Fig. 8, and is useful in surrounding the trunk or limbs. If the square piece is folded so as to unite two of its angles, it forms the **Triangular Compress**, Fig. 9.

This compress will be found exceedingly useful in confining dressings to stumps, where it is desirable to remove the dressing frequently without deranging the limb, as in the use of

Fig. 9.



poultices, etc. To apply one for this purpose, cut it of such a size as will surround the limb, place the stump in the centre of the side *a b*, Fig. 9; then turn up the apex *c*, and afterward the points *a* and *b*, confining them by pins. Then, when it becomes necessary to change the poultice, loosen the ends, and, turning them back, the surface will be exposed to view.
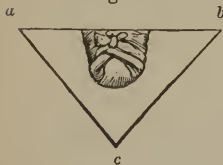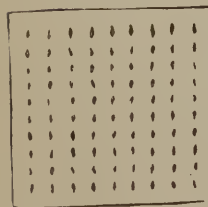
The **Cribriform Compress** is a square piece of linen in which a number of holes are cut. It is formed by folding linen four or six times on itself, so as to make several oblong squares, one within the other, and then nicking the sides in several points with the scissors, so as to remove small pieces. On opening it we shall have the form desired, Fig. 10. When spread with cerate and applied directly to a suppurating surface, the pus, passing out through the holes, will allow the compress to remain directly in contact with the surface, and thus prevent the wound from being constantly

Fig. 10.



bathed in matter, which sometimes is unhealthy. The cerate with which this compress is spread is useful not only by favoring the removal of other portions of dressings, but also when thus kept directly in contact with the granulations, by promoting cicatrization.

The **Maltese Cross**, so named from its shape, is made from a square piece of linen, by folding it first into an oblong square; doubling this so as to form a smaller square; joining the two angles to form a triangle, as in Fig. 11, and folding this equilaterally, to form a smaller triangle. Then mark a line on its hypothenuse half an inch from its apex, and slit the sides down to this line, as in that which is dotted in the figure. On opening

Fig. 11.



Fig. 12.
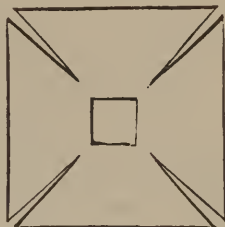


out the linen, we have a very regular cross, with a space in the centre, Fig. 12, intended to cover the front of the stump, while the angles go around it, and can be neatly adjusted to the convex surface of a stump without creating folds. This cross is mainly used as a primary or secondary dressing in amputations.

The **Half Maltese Cross**, Fig. 13, is formed by slitting the two angles of the loose side of an oblong square to within an inch or two of their centre, as seen in the figure. In some cases it serves a better purpose than the full cross, as in dressing stumps at the shoulder or hip joint. If the linen is doubled and cut in this form, it will, when opened out, form the cross, Fig. 12, as readily as the one in the plan there stated. In order to appreciate the

Fig. 13.



value of these directions, the student should repeat them on a piece of paper. A little practice with the scissors according to the lines just described will soon render very easy the manufacture of these portions of dressings.

The **Retractor of Two Tails**, Fig. 14, is made of an oblong piece of muslin split as represented in the figure, and intended to be used as a shield to the soft parts in amputations where there is but one bone to be divided by the saw, as in the arm or thigh. In applying

Fig. 14.



it, draw the tails downward on each side of the bone, and the upper part or body of the retractor upward over the stump, so as to force back the muscles and protect them from the action of the saw. The diamond-shaped opening at the end of the split is intended to adapt it more accurately to the bone itself.
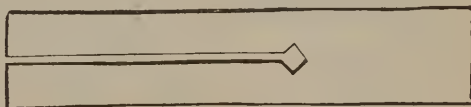
The **Retractor of Three Tails**, Fig. 15, is made like the preceding, only the muslin is split into three tails instead of two. It is employed in the same manner, in amputations where there are two bones to

Fig. 15.
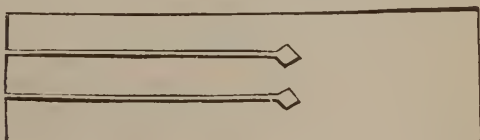
be divided, as in the forearm and leg; the third or middle tail being pushed through the interosseous space, so as to protect more thoroughly the soft parts around both the bones.

The **Perforated Compress**, Fig. 16, is the name given to a piece of muslin folded several times on itself, so as to make a thick mass, in the centre of which an opening is cut. It is used in order to relieve points

Fig. 16.

from pressure, especially where they have a tendency to slough, as on the internal condyle in fractures of the elbow, or on the trochanter of the femur, or on the heel, in fractures of the lower extremity. The sore point being placed in the centre of the opening, is saved from the weight, while the pressure is borne by the circumference. Frequently it is made out of a small pad or pillow, cut and formed like a broad ring. A very excellent article of this kind is now made of India-rubber cloth, so that it can be inflated. Such pads may be obtained at most manufactories, and should be made indispensable articles in hospital practice. But in any case, strict attention must be paid to the parts of the limb pressed on by the circumference of the opening.

**Graduated Compresses** are named from their construction, and are of several kinds; the substance of each being folded differently, according to the object in view.

The **Graduated Compress** is made by folding a piece of muslin several times on itself, so that each fold may not entirely cover the one that has preceded it. It may be graduated at one end, as in the cut, or from end to end, as would be the case if Fig. 17 had another folded end at its left extremity.

Fig. 17.
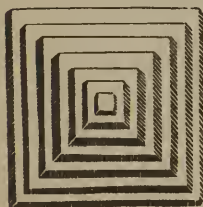
The **Pyramidal Compress** is one that is most accurately formed by placing square pieces of muslin, gradually decreasing in size, on top of each other, and stitching them together so as to form a pyramid, Fig. 18. It may also be made by folding a piece of $2\frac{1}{2}$-inch bandage on itself, so as to form a pyramid graduated from end to end, and then placing a piece of cotton or other substance in the centre of the last turns, Fig. 19. Thus formed, it is very useful in making pressure upon certain points, as in cases of hemorrhage from the deep-seated vessels of the leg or forearm.

Fig. 18.

Fig. 19

**Adhesive Strips** are pieces of linen spread with some adhesive plaster, usually Diachylon, and intended to promote the union of divided parts by approximating their edges or protecting the surface from the action of the air. As this plaster is kept very generally by the druggists, the formula for its composition would here be out of place. When old, the oxidation of the lead renders the plaster dry and stiff, and requires that it should be gently warmed in the sheet by holding it before a fire, before cutting the strips. The strips may be prepared from the sheet by sliding the scissors according

to the line of the thread of the cloth, so as to slit it into pieces about three-quarters of an inch in width, Fig. 20, and of a length sufficient to enable it to extend at least three inches beyond each side of the wound. Before applying the strips, it is generally necessary to soften the plaster by heat, and the most convenient method of so doing is to fill a bottle with boiling water and wrap the strip around it; the cloth side of the strip being next the surface of the bottle. In its application to wounds, the strip should be first placed on that portion of the wound which is most depending, in order to draw it up to the other, and not applied from above downward. The intervals between each strip should be such as will allow of the free escape of matter. In order to remove the strips from a wound without injury, wash the part with warm water, or apply a warm poultice to it a few hours before the dressing is to be changed. After this, let the dresser lay hold of one of the extremities of each piece in succession, and, gently raising one end, reflect it upon the wound to within an inch of the edge. Then detach the other to about the same distance, Fig. 21, and subse-

Fig. 20.



quently holding the two ends together between the thumb and finger of one hand, lift the strip perpendicularly from the part, taking care at the same time to apply the thumb and index finger of the left hand on the sides of the wound, to prevent too great stress upon the new cicatrix.
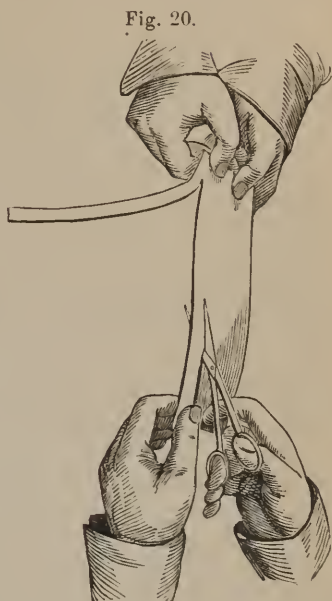
Adhesive strips sometimes irritate and inflame the skin, owing either to their tearing out the small hairs or down which cover it, or to the plaster being badly made, and their application is, therefore, frequently followed by erysipelas. In this case their place may be very well supplied by the slit and tail, or uniting bandage, or by the collodion, as hereafter shown. Adhesive strips are also much used as a dressing to ulcers; for

Fig 21.



compression in cases of epididymitis or hernia humoralis, etc. etc.
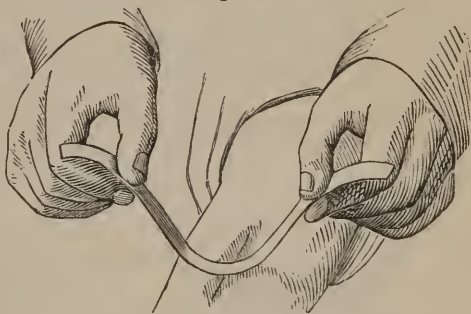
It may perhaps be useful to the young surgeon to mention, that the use of adhesive strips on suppurating surfaces often creates a marked blackness of the adjacent skin. This is nothing but a chemical change produced in the plaster by the action of the discharges, and not the forerunner of gangrene, as might be supposed.

Considerable objection has been raised within the last few years to the use of adhesive strips as a means of uniting wounds, on the ground that they proved irritating, and gave rise to erythema and erysipelas. As a substi-

tute for it, the *Isinglass plaster* has been highly recommended in England
as possessing equal adhesive powers, and having the advantage, on account
of its transparency, of enabling the surgeon to see the state of the wound
through the plaster.

"Isinglass plaster is composed," according to Mr. Liston, " of a solution
of isinglass in spirit, and may be spread for use, as occasion requires, on slips
of oiled silk; on silk glazed on one side only, and on the unglazed side.
This plaster is cut into strips of the desired breadth, and the adhesive matter
dissolved immediately before it is employed, by the application of a hot,
moist sponge." It is liable to the objection that the warmth of the part
and the discharges are apt to soften the material to the same extent that
the sponge did previous to its application; in consequence of which it loses
its hold.

**Collodion, or Liquid Adhesive Plaster.**—In the use of collodion it is
generally sufficient simply to paint the surface of a superficial wound a few
times with a camel's-hair pencil. But in more extensive injuries, strips of
kid or muslin may be wet with the solution, and then, the wound being closed,
pressed on the part until dry, this usually happening in a few minutes after
the application, from the rapid evaporation of the ether.

**Court Plaster,** sometimes called gummed silk, is occasionally used in slight
wounds and excoriations, although mainly in domestic practice. The Eng-
lish court plaster, which is generally deemed the best, is made by placing one
part of choice isinglass, cut into little pieces, in an earthenware vessel upon
a sand bath, and digesting it in four parts of water. When this is dissolved,
it is strained through a fine linen cloth; eight parts of alcohol are added,
and it is evaporated to one-half, again strained, and the tepid liquid then
spread upon black silk with a camel's-hair pencil. Four or five layers are
thus put on, care being taken to see that the former is perfectly dry. Between
the last two coats of the icthyocolla, a little tinct. of benzoin or bals. Peru
is added to give it an agreeable flavor. Thus prepared, the plaster is allowed
to dry for twenty-four hours. When used, a piece is to be moistened and
immediately applied.

**Poultices** or **Cataplasms** are different kinds of pulp or pastes, intended
to cover injured surfaces, the character of the substances being varied accord-
ing to the object to be gained from their application.

The **Emollient Poultice** may be made of any mild, unirritating substance,
as bread and milk; bread and water; bran and water; corn-meal and water;
and ground flaxseed, or flaxseed meal. The latter forms decidedly the best
poultice, not only as regards its properties, but also its economy. It is pre-

Fig. 22.
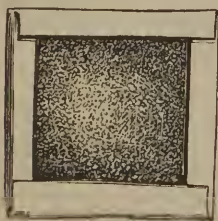


Fig. 23.
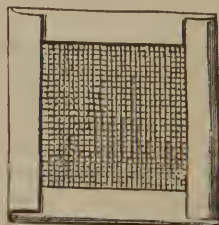


pared by pouring hot water on the meal, and stirring it till the paste acquires
such a consistence as will prevent its running from softness, or drying and
breaking off from being too stiff. In order to spread the poultice, a portion

of the paste should be dropped on a suitable piece of muslin, and leveled of an even thickness, say about one-fourth or half an inch; the free ends of the muslin being then folded over so as to form a sort of frame or border, and prevent the adhesion of the edges, or their hardening, Fig. 22. If the meal is not fresh it will be necessary to rub a little sweet oil or lard over the surface of the poultice, or to cover it with a piece of fine gauze previously softened in warm water, which will prevent its adhesion to surrounding parts, Fig. 23.

Every poultice should be renewed at least twice in twenty-four hours, or more frequently if it becomes hard and dry. Care must also be taken that the meal has not fermented, or the oil, if used, become rancid, as the application will then irritate instead of soothing the part. The bread and milk, or bread and water poultice, is made by breaking the crumb of bread into either of these liquids till they have the proper consistence, when they may be spread and used like that first mentioned. This and every other poultice will be more useful if covered on the outside by a piece of oiled silk, as this prevents the substance becoming hard and stiff.

The **Arrow-root Poultice** is a mild, unirritating, mucilaginous poultice made by scalding the fecula of the arrow-root, and bringing it to the consistence of starch, then applying it either directly to the part or in a thin bag.

The **Astringent Poultice** is formed by adding any astringent article to an ordinary poultice. Frequently it is made of bread and lead-water, or of the curd formed by throwing alum into boiling milk and straining off the whey, or rubbing up alum with the white of egg. The oak bark, pomegranate, persimmon, nutgall, bistort, tormentilla, etc. are also sometimes employed, beaten into a pulp, or mixed with other and more glutinous or farinaceous substances. They may be added to these in any proportions.

The **Stimulating Poultice** is formed of various substances, as boiled carrots, grated down to a pulp; raw potatoes, grated and applied cold; grated onions; grated horse-radish; cloves of garlic; black pepper; or corn-meal and some fermenting liquor, as yeast or porter. An excellent stimulating poultice, especially adapted to scrofulous or indolent ulcers, may be made by thickening strong brine with corn-meal; but to prevent its drying too rapidly this poultice must be spread on or covered with the oiled silk as before stated. Guano and flaxseed meal, equally mixed or more diluted, also forms a valuable though offensive poultice.

The **Fermenting Poultice**, or that made of corn-meal and porter, it must be especially remembered, should always be spread on or covered with oiled silk, and should likewise be covered by the gauze to prevent its adhesion. In cases of sloughing, mortification, hospital gangrene, etc. it will be found of great service. A fermenting poultice to be well made requires at least twelve hours to prepare, in order that the process of fermentation may have thoroughly extended itself throughout the mass.

The **Mustard Poultice** or **Sinapism** is prepared by mixing flour of mustard with water, to the consistence of that which is commonly employed for the table, and then spreading it very thinly on muslin, allowing it to remain on the part only till it reddens it, be it five or fifty minutes. The vinegar with which the mustard is sometimes mixed, so far from increasing its powers of stimulation, materially weakens them.

**Narcotic Poultices**, or those containing opiates, as poppy heads or powdered opium, etc., will sometimes prove very serviceable, and may be made by the addition of any of these substances to an emollient poultice.

To confine a poultice to a part, some of the bandages or handkerchiefs hereafter mentioned may be employed, at the option of the surgeon.

Plasters are made of various substances, and are occasionally employed to soften indolent tumors, procure their resolution, or hasten their suppuration. In their preparation the surgeon has no part, as this properly belongs to the apothecary. He may, however, be required to direct the shape of them, in order to insure their more accurate application. In general, nothing more is necessary to adapt a plaster to a part than to slit the angles which project when the plaster is applied to the surface. But in the plaster for the female mammæ a peculiar shape is required, which may be best obtained thus: Fold a piece of paper on itself, so as to form a perfect square of the size required; fold this so as to make an oblong square; double it and fold its angles so as to make a smaller square; fold this into a triangle, and round off its upper angles, as in the dotted line, Fig. 24. Then cut off semi-circularly as much of the point as will make an opening large enough to admit the nipple, or more if desired, and slit the sides at the circumference for one inch toward the centre. This, when opened out, will give the figure required, Fig. 25, and will enable any one to spread a plaster of a proper shape.

Fig. 24.

Fig. 25.

Irrigation, or the water-dressing, is the term applied to certain dressings which are intended to keep parts constantly moist, and thus diminish an inflammatory action. In simple erysipelas of some extent; in phlegmonous erysipelas; in compound fractures; in sprains, dislocations, and other injuries to joints; and in cases of sloughing from excessive action, as after amputations, this affords a most excellent means of combating inflammation. In order, however, that irrigation may be most advantageously employed, considerable care and attention is requisite on the part of the nurse in its application, as well as judgment on the part of the practitioner, in selecting warm or cold water. Whichever is used, it is a matter of some importance to keep up a continual supply of the liquid, for if the stream is not kept up steadily there will be a constant change in the temperature of the part, and a reaction from cold to hot, or the reverse, which will do harm by exciting an increased circulation in the part. There may, also, be too great a degree of cold, or the patient become wet with the dressing, or suffer from cold in some internal organ; all which should be carefully prevented.
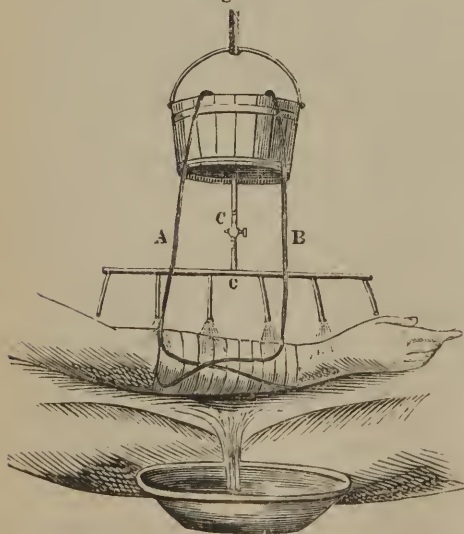
Fig. 26.

The simplest form in which irrigation, either with hot or cold water, can be properly arranged, is that shown in the cut, Fig 26, A, B, and C.

The limb to which it is to be applied should be first laid upon a piece of oil-cloth or coach curtain, to prevent the wetting of the bed and clothes of the patient, this being bent

on the outer side, so as to form a little gutter to carry off the water, after it has gone on the limb, into the vessel placed below. Then a pan, filled either with cold water, cold lead-water, or other cold or hot lotion, should be placed near the bed, at such a height as will be most convenient, and from it strips of patent lint twisted together, or, what is better, a piece of cotton-wick, as A and B, made to extend to another piece of lint covering the part affected. The wick being wet previous to its application, absorbs readily the fluid in the basin, or, in other words, forms a siphon.

Another mode of irrigation, which is neater, is by means of a tube with a cock, arranged as in the same cut at C. This may be made at a moment's notice by any tin-plater, or extemporaneously, of a piece of cane-angle and some quills.

In either case, if the patient complains of the cold or heat, it is easy, by means of the cock, or by plugs of wood introduced into the quills, to regulate the amount of fluid which shall pass over. But this is the only advantage which this apparatus possesses over the siphon, while the simplicity of the latter, and the facility with which it may be made and applied, recommend it strongly to favor.

### RULES FOR DRESSING.

It will now be seen that as the different articles employed in dressing are very varied, and the cases to which they are applicable equally so, it must be a difficult matter to give special directions as to their employment. Nevertheless, there are certain rules, founded on common usage, and such as experience has tested, that will prove advantageous to the young dresser, by enabling him to anticipate difficulties for which he would otherwise be unprepared. Thus, the choice of the position of both surgeon and patient; the selection of assistants; the order in which the different articles are to be employed, etc., may readily be reduced to general laws; while the modifications required for particular cases can be directed under special heads.

Before proceeding to any dressing after an important operation, it is necessary that every step of it should be anticipated, in order that nothing may be wanting. Proper assistants should also be ready, and each of them made fully to understand the duties that he will have to perform Especially is this necessary in the treatment of cases in private practice, where the surgeon is often obliged to take his assistants from among the friends of the patient. These, from a desire to aid, are generally very ready and willing to perform whatever may be asked of them; yet, when actually engaged, become faint, sick, hurried, or otherwise unfitted for duty, in consequence of some peculiarity of system, or from want of habit. As every surgeon has frequently experienced this, especially in serious cases, all will admit that the selection of assistants is a matter of importance.

The observance of the following rules in regard to dressing will be found to add very materially to the comfort both of the patient and surgeon.

1st. Let the surgeon make, or see made, everything that is requisite for the new dressing before removing the old one.

2d. Let him have a sufficient number of capable aids, to whom special duties shall be assigned before commencing the dressing, as this prevents confusion. Thus, in dressing a stump or wound there should be one assistant to support the limb; another to furnish hot water, and change it as required; heat the adhesive strips, hand cerate, etc. etc., by which means the surgeon can give his attention wholly to his dressing.

3d. Let him arrange the bed, as a general rule, *after* the dressings are changed ; or, if in a case of fracture, *before* the patient is placed on it.

4th. Let the position of the patient be such as will cause him no unnecessary fatigue.

5th. Let the surgeon, as a general rule, place himself on the outside of the limb with his face to the patient, as this will give more freedom to his movements, and prevent accidental jars.

6th. Let all the assistants be especially careful to guard against hasty and inconsiderate movements, in order to prevent unnecessary pain to the patient.

## SECTION II.

### OF THE PREPARATION AND APPLICATION OF THE BANDAGE.

By **Bandaging** is usually understood the confinement, in their proper situation, of dressings or other surgical apparatus, by means of pieces of muslin.

The term **Bandage,** in its strict signification, is only applicable to a collection of bands, or to such pieces of stuff as are fastened to one another and employed as a whole ; though general usage now justifies its application to the single strip or **Roller.** This roller is commonly a band of flannel, linen, muslin, calico, cloth, gum-elastic, or other substance, of different lengths and widths, rolled upon itself into a firm mass, so as to render its application to any part of the body more easy than it would be if simply folded up. As most frequently seen, the roller is formed of muslin, eight or ten yards long ; one, two, two and a half, three, or four inches wide, free from hems or darns, soft, pliable, and unglazed, to prevent its slipping. Thus made, bandages may be divided into two kinds : First, simple, or those formed by the application of the roller only ; and Second, compound, or those resulting from the complex arrangement of the pieces composing them, as in the double T-Sling, etc.

#### § 1 —Of the Simple Bandage, or Roller.

The **Roller** is to be prepared from a piece of muslin of the requisite length and width, by tearing it from the piece and then winding it into a cylindrical form, either by a machine or by the hand, so as to create one or two masses, and constitute what is called a **Single** or **Double headed Roller.** A machine for rolling bandages is seen in Fig. 27, and may well serve as a pattern for others, as its adaptation to the purpose has been long tested and found satisfactory. Various other machines, modified to suit peculiar views, are also used by surgeons, and thought to possess special advantages ; but the principle of all is the same. When, in hospital practice, it is desirable to economize material, and reapply a bandage several times, the use of a machine like that which I introduced into the Pennsylvania Hospital in 1837, will be found advantageous. It consists in a machine like Fig. 27, with the addition of two hollow steel cylinders between which the bandage is passed as it winds on the spindle. These cylinders, receiving a hot iron in their centre, smooth or iron the bandage as it passes between them.

In rolling a bandage on any of these machines one extremity of the band should be wrapped around the spindle, and wound up by turning the handle with one hand and directing the course of the band with the other, so as to insure its being wound evenly. Then seizing the roller firmly, reverse the

action of the spindle; draw it out of the cylinder and tear off all the loose threads, as they will not then unravel much if the cylinder is tightly rolled,

Fig. 27.
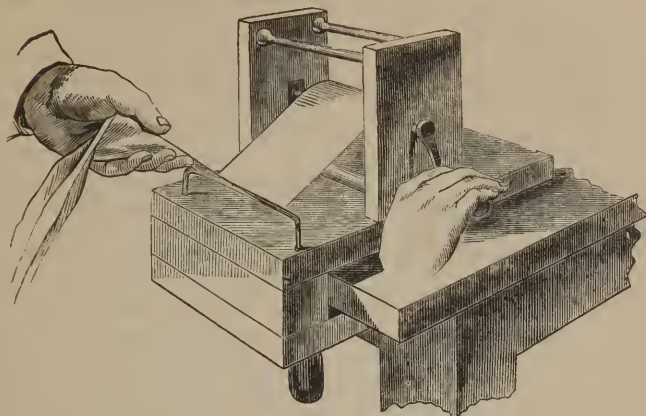


but will, if left, retard its application. If the threads are torn from the strip before it is formed into the cylinder, a large portion of the stuff will be wasted in raveling.

Thus formed, the **Single-headed Roller**, Fig. 28, consists of two extremities; of an initial or free end; of a terminal one, or that found in the centre of the cylinder; of two surfaces, an external and an internal, and of a body, or portion between the two extremities.

Fig. 28.



The **Double-headed Roller**, Fig. 29, has the same parts as the single one, except the initial end, which is wanting, in consequence of both ends being here wrapped into cylinders. The application of this roller, therefore, always commences with its body.

With a machine at hand, there can be no reason why every surgeon should not keep himself well supplied with bandages. But as a necessity sometimes occurs for the reapplication of the same roller, both from economy and

Fig. 29.



convenience, or from a surgeon being accidentally unprovided with a roller, he should early accustom himself to the manufacture of a bandage without using the machine. In order to do this with the greatest ease, the following directions will be found serviceable: Fold the terminal end of the band five or six times on itself, so as to form a sort of axis, and roll it a few times on the thigh to give it size. Then place the cylinder between the thumb and forefinger of the left hand; allow the body to run over the right forefinger, seizing it firmly between the thumb and finger of that hand so as to make traction, and tighten the cylinder. Having thus arranged it, give a rotary motion to the band, and cause the cylinder to revolve upon its axis by means of the fingers and thumb of the left hand, while, at the same time, the right thumb and forefinger revolve partially around the cylinder itself, which, by this compound movement, is soon formed as required.

Fig. 30 shows the position very well, and will explain the directions just given, simply by looking at it.

After a very little practice a student will find it an easy matter thus to roll

a bandage with either hand almost as quickly and tightly as it can be done on the machine, although at first the movements will seem to be very awkward.



Fig. 30.

When a roller is intended for the body it should be twelve yards long and about four inches wide ; when for the head, five yards long by two inches wide ; when for the extremities, eight yards in length, and two, two and a half, or three inches in width, according to the size of the limb, the thigh requiring a roller to be a little wider than that used for the leg. A finger or penis bandage should not be more than one inch in width.

In order to apply the single-headed roller to any part of the body it should be held between the thumb and fingers of either hand, and pressed by the fingers firmly against the palm, so as to prevent the cylinder from slipping out of the hand as it unrolls, which it is apt to do if held so that its internal surface would be the part first applied. Or, it may be held by placing the thumb and first and second fingers of either hand on the two extremities of the cylinder. In either case, the *external surface of the free end* must be the portion first applied to the part, and this should be retained there by pressure of the fingers of the left hand until one or two turns are made round the part, so as to fasten the end firmly ; after which the roller may be carried up the limb.

**Bandages** have been divided into several kinds, either according to the direction which they take in covering the part, or from the object to be attained by their application. Thus, we have the Circular, Oblique, Spiral, Figure of 8, Spica, and Recurrent, of the first kind ; and the Uniting, Dividing, Compressing, Expulsive, Retaining, etc. of the second.

A **Circular Bandage** is one formed by horizontal turns of a roller, each of which overlaps, or very nearly overlaps, the one which preceded it.

In the **Oblique,** the turns rapidly ascend the limb, or pass obliquely to its axis.

In the **Spiral** they mount gradually ; the **Spica** forms a figure like the leaves of an ear of corn ; and in the **Recurrent,** the folds run backward and forward to the points whence they started.

The **Uniting Bandage** is named from its action, and is that which is sometimes used to bring together the edges of wounds, and should be adapted to their direction, according as they take a longitudinal or transverse course, and will be again referred to under the head of Wounds.

The **Dividing Bandage** is one which is used to prevent the formation of cicatrices, as in the treatment of burns, or of wounds attended with great loss of substance.

The **Compressing Bandage** is the name given to any bandage which is employed for exerting compression, as in œdematous swellings, callous ulcers, varices, aneurisms, etc.

The **Expelling Bandage** is employed in the treatment of deep-seated abscesses, fistulæ, contused wounds, etc. It is usually a roller applied over compresses, upon the region wherein the matter to be expelled is situated,

and acts by preventing these fluids from traveling along the interstices of the muscles, etc.

**Retaining Bandages** are those which serve to confine dressings and displaced parts in their proper situation, examples of which are seen in those used in the treatment of fractures and dislocations.

The necessity which so often presents itself of applying to the different parts of the body some of the bandages just referred to, has rendered the study of bandaging one of the important points of a student's education ; yet, from its having been too generally overlooked, it not unfrequently happens that a practitioner finds himself in charge of a case requiring considerable skill in dressing, before he has gained as much dexterity as would be possessed by any good surgical nurse. If, then, it is deemed desirable to avoid vexation, or if he wishes to perform a duty in the manner that its importance deserves, every student will at once take a roller in hand and exercise himself until he has acquired such manual skill as practice alone can furnish.

Any bandage which does not give perfect support to the parts, maintain them in the position necessary to insure the fulfillment of the indication proposed, or exert on the member an equable compression, is useless, or worse than useless, as it may produce such a condition as will eventuate in the loss of the limb, or even of life ; and this loss should rightly be charged to the defects of the medical attendant. Their proper application is, therefore, a matter of great importance.

In no department of surgery, says Dr. Hennen, "will the reputation of a young practitioner be more seriously involved than in that referring to the application of the bandage. Our young surgeons may study, philosophize, and reason well ; but neither books, nor reflection, nor arguments will teach the application of a bandage without repeated practice." Practice alone can give the dexterity which is so necessary for its proper employment ; and unless a bandage is properly applied, it had better be omitted ; for if too loose it will not fulfill its indication, and if too tight may produce gangrene.

The practitioner's reputation is also liable to considerable injury, as he will be sure to suffer from the judgment of those around him if he shows ignorance of this important duty. The majority of persons, says Hennen, "are ever attentive to the manipulations of any workman, and can soon judge, and judge correctly, whether or not he is acquainted with his business, consequently they do not hesitate to exercise their criticism to its fullest extent, in the case of the surgeon ; and when their opinion of his ignorance is confirmed by the patient's continued suffering, they are ever ready to disseminate it widely." On the contrary, when a bandage lays smooth and regularly on the limb, when the patient is relieved from previous torture, and the part assumes the neat appearance that always follows the visit of an experienced dresser, the confidence of friends is raised, and his subsequent visit is looked forward to with pleasant anticipations of relief.

Surgeons who, from want of practice, cannot produce the neat appearance of a well-applied bandage, are frequently induced, in order to escape the remarks so often made on this point by those around the patient, to resort to the wetting of the roller, in order to cause it to adapt itself more readily to the part. But this practice should never be permitted, unless we would wish to expose a patient to the risks of mortification, as it is impossible for any one to calculate how much a wet roller will shrink in drying, and consequently how great a degree of pressure it will make on a part after we have left it. A bandage may be at the proper degree of tightness at the time ; the patient make no complaints, and yet in three or four hours be suffering such agonies as must be seen or felt, to be properly appreciated. The ques-

tion, then, may very properly be asked, in regard to how much traction should be made in order properly to apply a roller? To a certain extent this must depend on the object to be attained in its application, as a bandage which is merely intended to confine a dressing need not be as tight as one that is used to compress muscles. But, as a general rule, a bandage is not too tight if the patient feels easy under it two or three hours after its application. Until, then, experience has taught the practitioner the degree to which a roller should be drawn, the fact must be recollected that one which is too tight will do serious injury, while all that can result from one that is too loose will be the non-fulfillment of the indications for its application. The young surgeon had, therefore, better guard against the first evil, as repeated evidence has shown that the tendency of all inexperienced dressers is to use too much traction on a bandage, and not too little. In order to learn the proper degree of tightness, it is only necessary to apply the roller on a friend, or, what is better, allow that friend to practice on us, when the suffering that will be inflicted by his want of skill will doubtless prevent the lesson being soon forgotten.

In the consideration of the special application of the roller, it is to be studied, first, according to the course which it takes around the part; and second, in reference to the object to be attained in its application.

## BANDAGES AS NAMED FROM THEIR COURSE.

### I.—THE CIRCULAR BANDAGE

Is that in which each turn overlaps the one that preceded it, so that the



Fig .31.

whole bandage looks like a single turn, and runs directly round the part, Fig. 31. All the circular bandages are very simple, and consist of: one for the Forehead, in which the turns encompass the vault of the cranium; one for the Eyes, to retain dressings to these organs; one for the Neck, as in the dressing of blisters, setons, etc.; one for the Arm, as in the compression of the veins previous to bleeding; and a few of a like nature for other parts of the body.
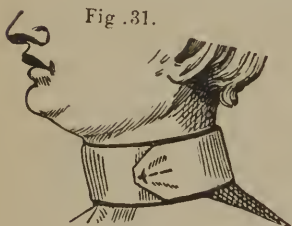
In the confinement of the terminal end of a circular, or any other bandage, two means are resorted to: first, the use of pins; second, the employment of little bands tied in bow-knots.

When pins are used, they should be placed either in the direction of the



Fig. 32.

length or breadth of the band. If in its length, the head should always be turned from the free end of the roller, Fig. 32, otherwise the tendency of the roller to become loose and the constant drawing against the pin will at last withdraw it entirely. On the other hand, if the pin is applied transversely, the head should always present to the upper extremity of the limb, in order to prevent the point from sticking in the fingers of the surgeon when his hand is passed down the part, either in smoothing the turns of the roller or in seeking for the end of the bandage in its removal, Fig. 33. A reference to Fig. 34 will show how the pin may be drawn out by the unwinding of the roller itself.

Some surgeons prefer fastening the end of a roller by means of a piece of tape, or by slitting it for a short distance into two strips and tying the pieces

Fig. 33.        Fig 34.                                     Fig. 35.



in a bow-knot, Fig. 35; but this fastening is seldom as neat or firm as the pin, except when bandaging the penis, fingers, or toes. In these portions of the body it will be found to be rather more convenient.

## II.—THE OBLIQUE BANDAGE,

Fig. 36, differs from the circular, in its turns being made less at right angles to the axis of the limb, in consequence of which the roller can be

Fig. 36.
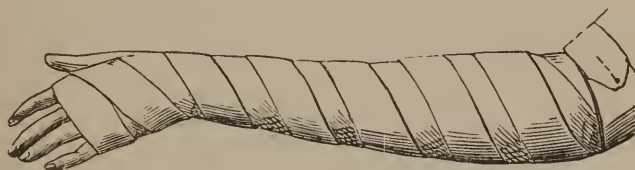


made to cover a greater extent of surface, as each turn passes a little beyond the one previously made, and follows a course which leaves a considerable space between the turns. The oblique bandage is chiefly employed in retaining dressings, although occasionally useful, especially when conjoined with other bandages, in cases which will be treated of hereafter.

## III.—THE SPIRAL BANDAGE

Is that which is most frequently employed in the treatment of all affections, whether of the extremities or trunk. Its turns ascend the limb less rapidly, are closer together, and cover the part much more firmly than the oblique, thus making a certain amount of pressure in addition to the retention of the dressing. Each turn of the spiral bandage should cover in at least one-third of the preceding turn; and as most of the parts to which it is applied are conical in their shape, especially in the extremities, it follows that in ascending from the lower to the upper portion of them we must pass from the apex of the cone to its base, and that, consequently, one edge of the roller will press on the limb, while the other will project from it, so as to make the openings designated as Gaps, as seen at a, b, c, Fig. 37. To obviate this, and cause the bandage to apply itself more perpendicularly to the whole surface of the part, or, in other words, to equalize the pressure, the roller must be half folded on itself, or a doubling

made, which is called a **Reverse**; and as the bandage by this action acquires an increased thickness, a greater degree of pressure will be made on the

Fig. 37.
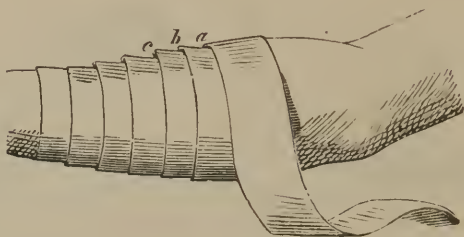


reversed points than at any other. It is therefore desirable, in order to obviate the welts and other bad effects occasionally resulting from these reverses, that the turn should be made as short and smooth as possible. To make a reverse is, therefore, a matter of much importance, and constitutes the first difficult step in bandaging; not that there is any real difficulty in the manœuvre, but simply because sufficient attention is not generally paid to its mechanism. The following rules, which constant practice and extended experience have established, will render the matter perfectly simple, and if observed, not only make the formation of a reverse very easy, but also make it almost impossible to prevent its proper formation :—

*Rules for making Reversed Turns.*—1st. Hold the roller in the position in which it is generally applied, that is, either by its body or its two extremities, the hand being in a state of supination. 2d. Apply the initial extremity to the limb, and continue to make simple spiral turns until you approach the enlarged portion of the limb. 3d. Apply a finger of the free hand to that portion of the bandage which is already in contact with the limb, not to assist in forming the reverse, or to fold it down, but simply to prevent the turns already applied from slipping or becoming relaxed while the reverse is being made. 4th. See that no more of the bandage is unrolled than will enable you to separate the cylinder a short distance, say four or six inches, from the limb. 5th. Keep that portion of the bandage which is between the finger, fixing the body of the roller and the cylinder, perfectly slack. 6th. Turn the hand holding the cylinder from supination into decided pronation, by a simple motion of the wrist alone, without moving the fingers from the cylinder, as shown in Fig. 38, taking especial care *to make no traction*, nor to sink the cylinder below the level of the limb till the fold or reverse is made, when it may again proceed up the limb, it being recollected that each turn should ascend spirally, and only cover in about one-third of that which preceded it. 7th. Keep each turn and each reverse parallel to its fellow.

As these reverses are indispensable wherever there is an increase in the size of the part, as from the development of muscles, etc , it is of great importance that the proper way of making them should be acquired, as no spiral bandage can well proceed six inches on an extremity without requiring their formation; and although they are generally regarded as the most difficult point in the application of the roller, a little attention to the rules just given, especially to that which requires that no traction should be made, nor the cylinder sunk below the limb, or widely separated from it while the reverse is being formed, will enable any one after a little practice to make them with great ease and neatness. To add to the latter, all the reverses should, as far as possible, be kept in a perpendicular line, as seen in Fig. 41, of the spiral of the upper extremity, and this will always result without

extra attention, from the observance of the direction to keep the edges of each turn parallel. I repeat, that the difficulties experienced in making

Fig. 38.
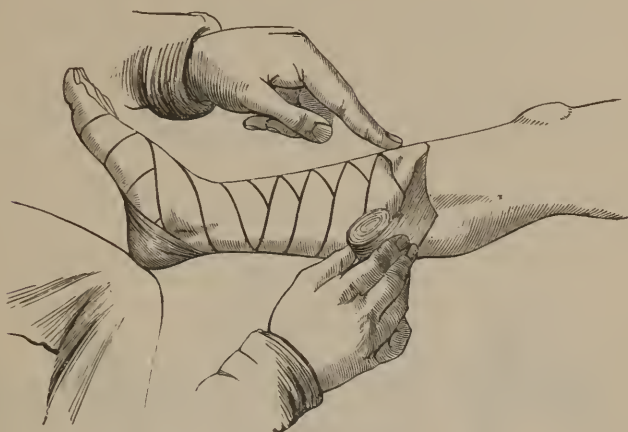


reverses, and the terrible, twisted, and corded things, sometimes made for reverses even by those who are good operating surgeons, are always the result of traction on the bandage while the reverse is making.

The special applications of the **Spiral Reversed Bandages** are as follows:—

## 1. *The Spiral of the Chest.*

The application of this requires a single-headed roller ten or twelve yards long and three or four inches wide, and that the patient should be sitting in such a position as will enable the surgeon to pass the roller readily behind his back. In applying the bandage, place the initial extremity on the waist, and conduct the roller spirally around the chest, each turn covering one-third of the preceding turn until the axillæ are reached; then carry the roller across the front of the chest, and form an oblique of the right axilla and the left side of the neck, Fig. 39. Each turn should be drawn with moderate firmness so as to compress the chest, and limit its action.

*Use.*—In fractures of the sternum, care being taken to apply compresses upon the

Fig 39.



projecting points. It is sometimes useful if the patient, from mania a potu or other causes, should be very restless, to add to this bandage the T-bandage for the body, shown hereafter, in order to prevent the roller from slipping; but, generally, the oblique turns of the neck and axilla will answer this purpose.
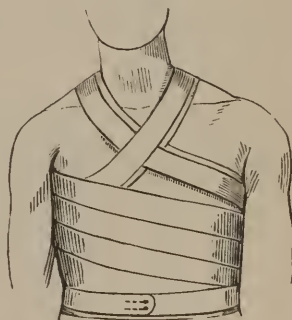
## 2. *The Spiral of the Abdomen*

Is formed of the same kind of bandages as the above ; but in its application we should commence at the lower part of the chest and carry the roller spirally round the abdomen from above downward, adding to it a single T, or making one or two oblique turns around the thighs to prevent its slipping upward.

*Use.*—To compress the abdomen, as in certain cases of tympanitis, or after the operation for tapping in ascites. But its place may be well supplied by a double T of the abdomen, when firm pressure is not required.

## 3. *The Spiral of the Penis*

Fig. 40.



Fig. 41.



Requires a bandage eighteen or twenty-four inches in length, one inch wide, and slit into two pieces at its terminal extremity. Then commencing at the glans penis, form an ordinary spiral which shall terminate at the root of the penis, and be confined there by tying the two ends, Fig. 40.

*Use.*—This is chiefly employed to retain dressings to the penis in cases of chancres and other sores external to the prepuce. It has also been used in the treatment of gonorrhœa, in order to compress the urethra, a catheter being left in it ; but it is very apt to produce erections, which do harm, and quickly derange the bandage. The sheath of the penis, spoken of hereafter, answers better in many instances, and especially in gonorrhœa.

## 4. *The Spiral of the Upper Extremity*

Requires a roller eight yards long, two or two and a half inches wide, and compresses if it is to be used to make pressure on particular parts, and act as a compressing bandage. In its application, having covered in the fingers, if necessary, by the gauntlet, as shown hereafter, commence with one or two circular turns around the wrist, in order to fix the end of the bandage ; then pass obliquely over the back and palm of the hand to reach the extremities of the fingers, and ascend by three spiral turns without reversing, until the phalangeo-metacarpal joint of the thumb is reached ; cover this and the wrist-joint by a figure of 8, such as is described hereafter,
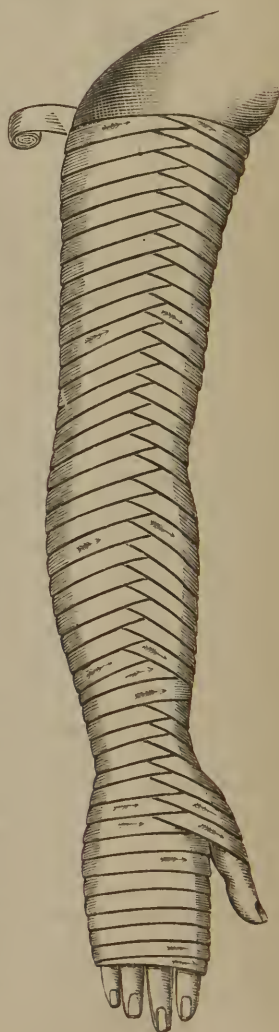
and ascend the limb by simple spiral and reversed turns till we reach the elbow. Cover this also by a figure of 8, if the arm is to be flexed; if not, by simple spiral turns without reverses, Fig. 41, and continue the spiral and reverse turns to the shoulder, placing compresses, etc. where they may be required.

This bandage is daily used to cover in, support, and compress the arm, as in varicose veins, aneurismal tumors, treatment of fractures, etc., and is, with the exception of the turns for the elbow, perfectly easy. Attention to the figure of 8 bandages will soon overcome the latter difficulty.

Its effects, when well applied, are excellent; but it may become very fatiguing and painful if drawn tight, and, if too tight, may produce gangrene, ulceration, etc. In 1837, it was found necessary, in the Pennsylvania Hospital, to amputate the forearm of a man who had only a simple fracture of the lower extremity of the radius, but whose arm was gangrenous from the malapplication of this bandage by an ignorant surgeon.

### 5. *The Spiral of the Finger*

Is composed of the roller known as the **Finger Bandage**, which is only one inch wide, of the requisite length, say one yard, and split into two ribbons at its terminal extremity.

As the spiral turns of this little bandage are employed by every one to retain dressings to the finger in cases of wounds, it may seem unnecessary to offer any direction for its application; but without a turn round the wrist it is very apt to become deranged.

To prevent this, it should always be applied as follows: Fix the initial extremity round the wrist by a circular turn, and cross the back of the hand, in order to descend either finger to its extremity by very oblique turns. Then, commencing at the extremity, make an ordinary spiral with reverses, and terminate the bandage either by a knot on the fingers, as seen in Fig. 35, or with a few circular turns round the wrist.

### 6. *The Spiral of all the Fingers, or Gauntlet,*



Fig. 42.

Requires a band eight yards long and of the preceding width, rolled into a cylinder. Then commence as in the spiral of one finger, by one or two circular turns around the wrist; pass obliquely over the back of the hand, and descend by oblique turns to the nail of the forefinger, after which ascend by spiral and reversed turns to the base of this finger; then pass to the middle finger; descend by oblique turns to its nail; ascend by spirals to its base, and so on, till all the fingers are covered, terminating at the base of the little finger. Then pass in front or on the back of the hand, to finish by circular turns around the wrist. The last turn in the cut is represented as much too wide; those on the fingers and hand are more correct, Fig. 42.

*Use.*—We may resort to this bandage when more than one finger is injured, and there is reason to fear their uniting if they are permitted to
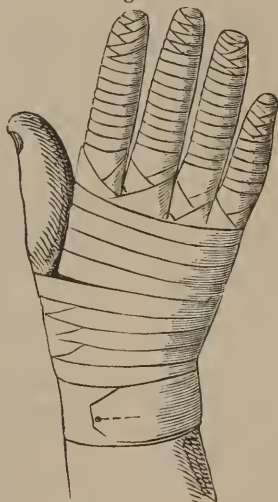
come in contact, as in cases of burns. If there is a necessity for retaining dressings at the metacarpal extremities of the fingers, or at the interdigital spaces, we may add to this the Demi-Gauntlet, Double T of the Hands, or the Perforated T, as hereafter shown.

### 7. *Spiral of the Palm, or the Demi-Gauntlet,*

Is formed of the same pieces as the preceding, and applied by making a few circular turns around the wrist, and then passing across the back or palm of the hand, as the case may be, by oblique turns which will pass from the root of each finger, or its interdigital space, to make a circular turn round the wrist, Fig. 43.

Fig. 43.

Fig. 44.
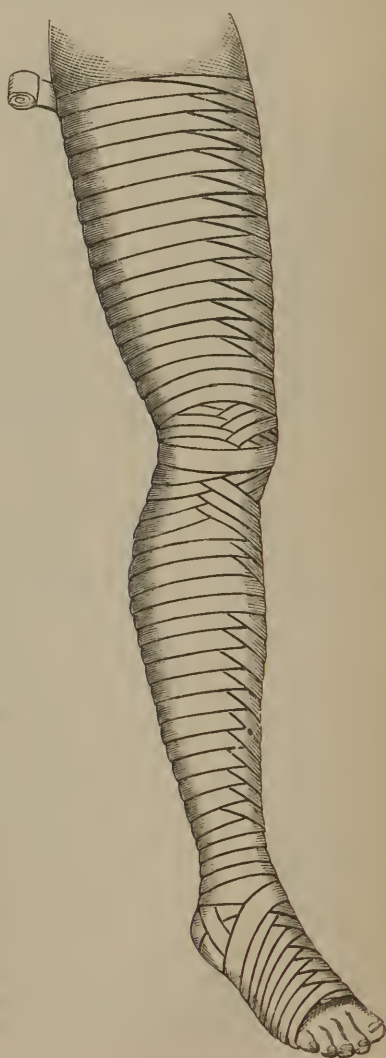


This very light bandage is chiefly useful in retaining dressings on the front or back of the hand. But its place may be supplied by the perforated T, or the double T of the hand, under certain circumstances.

As the Spiral of the Thigh, of the Leg, of the Foot, and of the Toes resemble each other, they may all be included in

### 8. *The Spiral of the Lower Extremity.*

This bandage requires two rollers, each seven yards long and two and a half or three inches wide, and that the patient be seated, with the extremity of his heel on the very point of the surgeon's knee, or else, lying down, with

the leg supported by assistants. Then, while the surgeon is either at the foot or on the outside of the limb, and either sitting or standing, let him commence by making one or two circular turns from without inward, immediately above the malleoli, in order to fix the end of the roller. Then descend, if in the right foot, from the external malleolus obliquely across the instep and under the sole to the extremity of the little toe; from this make two or three spiral turns upward so as to cover in the foot as far as the instep. After this, ascend the limb by spiral reversed turns, made with either hand, until the knee is reached, when this should be covered in by figure of 8 turns; after which proceed with the second roller to make spiral reversed turns on the thigh till the whole limb is covered, Fig. 44.

*Use.*—This bandage, if well applied, fulfills every indication that can be required of a bandage in fractures, ulcers, varicose veins, or œdema, and will usually keep its place for two or three days without being renewed, if the patient remains in bed.

The main difficulty in its application consists in the covering of the heel. This is not, however, absolutely necessary, as in many cases the close adhesion of the integuments to the parts below prevents any great amount of swelling; but where a considerable degree of compression is to be made on the leg, as in the treatment of varices, ulcers, etc., it is a better plan to cover it, which may be readily done as follows: From the top of the instep pass directly over the point of the heel, around the side of the ankle, to the front of the joint, down under the sole of the heel, directly around it to the opposite side of the

Fig. 45.



ankle, thence in front of the joint round under the sole and point of the heel to the side of the ankle whence you started, thus forming figure of 8 turns, Fig. 45.

The advantages of the circular turns round the ankle, when commencing this bandage, are, that it gives greater firmness and prevents the initial end from becoming loose. The French surgeons, however, usually begin to bandage at the toes, and do not cover in the heel, and their course may be followed, by those who prefer it, by observing the rules for the application of

Fig. 46.



### 9. *The French Spiral.*

The French Spiral is formed by applying a roller two and a half inches wide and seven yards long, as follows: Place the initial extremity of the roller on the outside of the instep, say of the right foot, and pass obliquely across to the ball of the big toe; go under the sole to the extremity of the little toe; and then make as many spiral reversed turns as will carry the bandage to the front of the ankle or the front of the astragalus. Pass from this around the malleoli, and ascend the limb by spiral reverses, as in the former bandage. The reverses of this and the former bandage being the same, are shown in Fig. 46, the main difference in the two being in the turns covering the heel and in the point of commencement.

This bandage is used for the same purposes as the ordinary spiral just described, but especially for the application
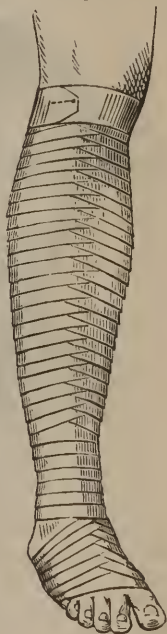
of the *Dextrine* or *Starch* Bandage, because it leaves the toes and heel open to inspection, which is all-important, and will be again referred to in the treatment of fractures.    Where it is necessary to make pressure on the instep, heel, or ankle, the Spica of the foot may be added to this.   (See Fig. 61, page 125.)

### IV.—OF THE CROSSED, OR FIGURE OF 8 BANDAGES.

The **Crossed or Figure of 8 Bandages** compose some of the best and neatest applications of the roller, and are named from their shape.   As a class they are exceedingly useful in covering in joints and other points requiring firm and solid compression.   They may be made either with the single or double headed roller; though, as the compression resulting from the turns of the latter is sometimes very painful, they require watching.

### 1. *The Crossed of one Eye*

Is made of a single-headed roller two inches wide and five yards long.

If the hair is long, cover in the head with a nightcap previous to the application of the bandage, as this will prevent the turns of the roller from slipping.   Then make two or three circular turns round the forehead and occiput, passing from right to left if for the right eye, and the reverse if for the left.   On reaching the nape of the neck in the third turn carry the roller under the ear of the affected side, and obliquely up over the jaw and injured eye, inclining it well to the internal canthus, so as to cover the root of the nose, but not so as to affect the sound eye.   Pass hence, across to the temple of the sound side; descend to the nape of the neck, and make two or three oblique turns, similar to these, terminating the bandage by circular turns around the forehead, Fig. 47.
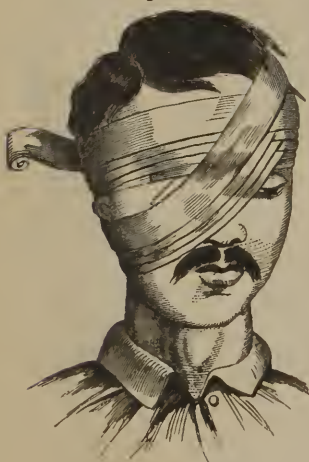
Fig. 47.                                          Fig. 48.
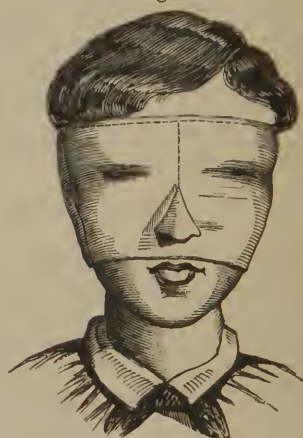


*Use.*—This bandage answers tolerably well to retain dressings to the eye, but is very readily displaced by the movements of the patient, unless pinned fast to the cap first applied.   When it is desirable to make pressure on the eyelids, as in the treatment of gonorrhœal ophthalmia, cancer, etc., this bandage may prove useful; but the circular bandage of the eyes, seen in Fig. 48, is preferable for simple dressings.

## 2. *The Crossed of both Eyes*

Is made by a single or double headed roller seven yards long and two inches wide, with compresses, if required.

In its application, make two or three circular turns of the head, turning indifferently from right to left, or the reverse; then on reaching the back of the neck pass under the ear of either side, up over the eye, root of nose, and parietal protuberance of the opposite side, to return to the neck. Make two or three turns similar to these, and at the third turn pass from the parietal protuberance round the forehead, instead of round the occiput; cross the root of the nose, the eye, and cheek of the opposite side, making an X with the first turns, and proceed in oblique turns as before; terminating by circular ones.

*Use.*—This bandage, on account of the crossing of the turns on the forehead, is much more solid than the former, and may be employed in similar cases. It will add, however, to its solidity to cover the head, after its application, with a handkerchief or nightcap.

Pressure may also be made simply by applying a broad piece of linen around the eyes, and cutting an opening to permit the exit of the point of the nose, as in Fig. 48, provided compresses are first placed over the eyelids.

## 3. *The Crossed of the Angle of the Jaw*

Requires a single-headed roller, two inches wide, five yards long, and a thick compress.

In applying it, carry the initial portion of the bandage round the forehead, and fix it by two circular turns of the vault of the cranium, turning from the right to the left and backward, if the disease is on the left side, and *vice versa.* From the nape of the neck, direct the roller close under and behind the ear of the sound side, under the jaw to the angle of the jaw on the injured side, and place the compress behind and on this angle. Then carry the roller over the compress, up over the side of the face, between the eye and ear, obliquely over the vertex, and down behind the ear opposite the injured side. Make thus three or four obliques, as seen on the right side of the cut, and, reversing the last turn, terminate by circular turns around the forehead, Fig. 49.

*Use.*—This is an excellent bandage for the treatment of fracture of the neck and angle of the jaw, and the only one I know of that fulfills the indications for the treatment of this injury, as it forces the angle forward and inward to the anterior portion, and counteracts the action of the pterygoid muscles. It will, also, be found useful in tumors of the parotid region, in retaining dressings to this part. No circular turns should be made around the chin and neck, as sometimes recommended in the treatment of fracture of this part of the jaw,

Fig. 49.
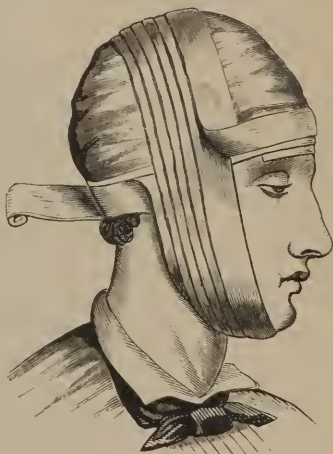
as they tend to displace the fragments, and push the chin too much backward.

#### 4. *Barton's Bandage, or Figure of* 8 *of the Jaw,*

Is formed by a single-headed roller five yards long and two inches wide, the initial extremity of which should be placed just below the prominence



Fig. 50.

on the os occipitis. Then continue the roller obliquely over the centre of the parietal bone; across the junction of the coronal and sagittal sutures; over the zygomatic arch; under the chin; and pursue the same direction on the opposite side until you arrive at the back of the head. Passing now obliquely around and parallel to the base of the lower jaw, and over the chin, continue the same course on the other side till it ends where you commenced; whence it runs exactly as before, a pin being placed at the vertex, Fig. 50.
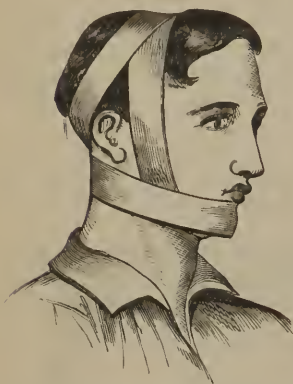
*Use.*—For this beautiful specimen of a bandage we are indebted to the skill and ingenuity of Dr. J. Rhea Barton, of Philadelphia, a surgeon to whom the profession owe many important and novel operations, while his skill in the use of bandages is unsurpassed by any. Although this bandage may be looked on as a small affair compared with some of his improvements, yet it is perhaps the one most likely to be tried by the generality of practitioners, as it is one of the best dressings for fractures of this bone, anterior to its angle. In order to apply it neatly the roller should not be over *two inches wide*, and the turns should be made to follow as nearly as possible those which have preceded them, so as to give the appearance of but a single turn.

#### 5. *The Crossed, or Posterior* 8 *of the Chest,*

Requires a roller seven yards long, two and a half or three inches wide, and compresses, tow, or cotton, to place on the anterior edge of the axillæ, in order to prevent the bandage from chafing them. Then, while the patient is sitting, with the shoulders well drawn back by an assistant, and the compresses are held in front of the axillæ, carry the initial extremity of a roller around the superior part of one arm, say the left, and make three or four spiral reversed turns from before backward, and from within outward. From this shoulder pass obliquely over the back to the right axilla, the shoulders being well forced backward. Ascend in front of, and over the shoulder; pass over the back to the left axilla; over the compresses in front of this axilla and round to the back; over the back to the right axilla; over it in front; and over the back to the left axilla. Pass again the same course till the roller is nearly exhausted, when it may be terminated by circular turns of the body, or of the right arm, Fig. 51.

*Use.*—This bandage will act either as a uniting one for the back, or a divisive one for the front of the chest, and was formerly much employed in the treatment of fractured clavicle. But as its place has since been supplied by others which are better, it has consequently fallen into disrepute, though it may occasionally be a useful addition to the means of treating such acci-

dents, when it is requisite to carry the shoulder well backward.    It will also prove useful in uniting longitudinal wounds of the back, or in preventing contractions from burns, etc., on the front of the chest.

Fig. 51.



6. *The Anterior 8, or Crossed of the Front of the Chest,*

Is in its action the reverse of the one just described, although its composition is the same.    Its application can be readily understood from an

Fig. 52.



inspection of Fig. 52, and what has just been said, being simply anterior

instead of posterior turns of the body. It draws the shoulders forward, and will, of course, unite longitudinal wounds over the pectoral muscles, or prevent contractions in the cicatrices of burns on the back. By placing compresses over the upper part of the sternum, it may also be usefully employed in injuries of this part, as well as in dislocations, anteriorly, of the sternal end of the clavicle.

### 7. *The Spica of the Shoulder,*

Like most of the spica bandages, forms one of great neatness, and is well calculated for making pressure on this part. It is formed by a roller eight yards long and two and a half inches wide, with cotton or compresses for the axilla of the injured side.

In applying the bandage, commence by making one or two spiral reversed turns round the upper part of the arm of the injured side, passing from without inward, and from before backward. Then pass from behind the arm, up over the lower extremity of the same shoulder; obliquely downward, over the front of the chest to the axilla of the sound side; thence round the back; obliquely upward, over the shoulder, and down in front under the axilla of the injured side, which should be previously furnished with the compress or cotton, in order to protect it. From this point go behind and over the shoulder, to pursue exactly the same course as before, until the bandage is nearly exhausted, each turn covering in, however, only one-third of the preceding turn. Then terminate it by one or two circulars of the trunk, or of the arm, and pin it, as in Fig. 53.

Fig. 53.



*Use.*—This beautiful bandage, named from the resemblance in its folds to the arrangement of the leaves of an ear of corn, exercises a very exact compression around the extremity of the shoulder, at a point where it would otherwise be difficult to make pressure. In cases of dislocation of the humeral extremity of the clavicle it will be found of great service in keeping the clavicle reduced, especially if the arm be also well supported. But

great care is requisite to protect the edges of the axilla, otherwise they will
be injured by the turns of the roller.

When this bandage is made to mount gradually from the point of the
shoulder toward the neck, it is called a *spica ascendens;* but if its turns
come from the neck to the shoulder, it becomes a *spica descendens.*    Of
course, it is optional with the surgeon to make either the one or the other,
as the result depends on the point where the first turn, after leaving the arm,
is made to cross the chest.

### 8. *The Figure of* 8 *of the Neck and Axilla*

Is formed by a roller five yards long and two inches wide, the initial
extremity of which is placed on the side of the neck, and fixed by one or two
circular turns of the neck, loosely applied; making them, for example, from
behind forward, and from left to right.    Next, direct the roller as it comes
from the left side of the neck, over and behind the right shoulder, so as to
enable it to confine any dressings that may be required either there or in the
axilla; then come up in front; over the shoulder; round the neck to the
left side; and cover by each turn only one-third of the preceding turns, so
as to make a figure of 8, one turn of which shall embrace the neck and the
other the axilla, Fig. 54.

Fig. 54.
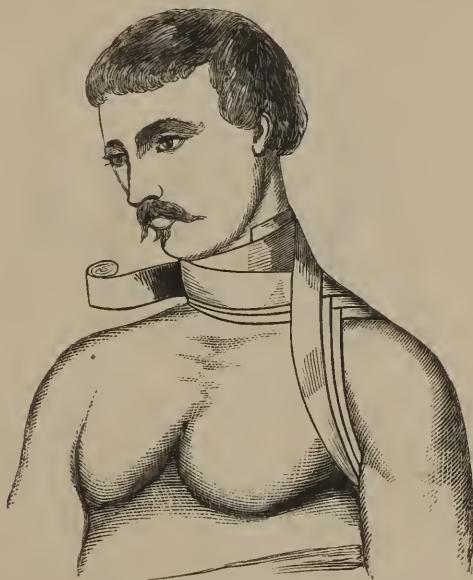


*Use.*—This bandage will prove useful in retaining dressings before, behind,
or above the shoulder, or in the axilla, or at the base of the neck, as it is
easily applied, and if not drawn too tight does not restrain the motions of
the arm.    It may also be made with a double-headed roller, the body of the
bandage being applied under the axilla, and the heads crossed upon the
shoulder of the opposite side, and then brought round the neck to cross on
the shoulder of the injured side.    It is firmer as thus applied than the single-
headed roller, but is apt to press too much on the armpit and interrupt the
circulation, or cause cramps in the hand, if care is not used in its application.

### 9. *The Crossed of one Breast*

Requires a roller eight yards long by two and a half inches wide; that the patient should be sitting up without the back touching a chair, and that the surgeon should stand in front, or on the outside of the limbs of the patient, and not in front of her knees or behind her back, as the last turns of the bandage are apt to render such a position extremely awkward.    In applying this bandage fix the initial extremity of the roller behind the shoulder of the affected side, say the right; then carry it obliquely across the back, over the opposite shoulder, and descend on the front of the chest to pass from before backward under the breast and axilla of the injured side.

Fig. 55.



Fix by this turn the initial extremity of the roller, and go over the same course once or twice, so as to form two or three oblique turns of the neck and axilla.    Then, on coming to the axilla of the diseased side the third time, direct the roller transversely across the back, to the axilla of the opposite side, and return by a horizontal turn in front of the chest to the point of departure, in order to commence another oblique of the neck and axilla. Continue thus making oblique turns of the neck, and horizontal turns of the body, each turn ascending and covering in one-third of the preceding one, till the roller is exhausted, when it will be found that the breast is firmly supported by the oblique, and compressed by the circular turns, Fig. 55.

*Use.*—This bandage is not only useful in retaining dressings to the breast, but also in supporting the breast itself when requisite, as in cancer, lactation, etc.    It will readily keep its place for thirty-six hours, unless handled. It may, however, if it should be requisite to change the dressings twice or thrice a day, be supplanted, in cases of simple dressing, by the sling of the breast, as hereafter described, and the patient will thus be saved the fatigue of a reapplication of the bandage.

### 10. *The Crossed of both Breasts*,

Having more surface to travel over, requires a roller twelve yards long and two and a half inches wide, rolled either into one or two heads. If the patient is very large it may require a roller of fifteen yards. In order to apply it, carry the initial extremity of a single-headed roller behind the right axilla; thence by crossing the back, direct the cylinder over the left shoulder; pass obliquely across the front of the chest, under the right breast, and under the right axilla to the point of departure. Make thus two or three obliques of the neck and axilla, covering in the breast by the gradual ascent of each turn, and on reaching the back of the right axilla in the third turn, pass transversely across the back to the left axilla; under this and across the chest in front of the left breast to the right side of the neck; thence across the back to the left axilla. Make thus two obliques of the neck and this axilla, and on coming to the front of this armpit pass transversely under both breasts to the right axilla, and under this to the point of departure, taking care that each revolution covers successively the breasts from below upward, without being drawn too tight. If the course here laid down be rigorously followed, we shall have an oblique of the neck and each axilla, with horizontal turns before and behind, so that each turn of the roller will be found to mould itself with great accuracy to the roundness of the breasts and make gentle and equable pressure on them, a point of some importance in certain cases of mammary abscess, Fig. 56.

Fig. 56.



*Use.*—This bandage, like the preceding one, is employed to support or compress both breasts, and is exceedingly useful in patients who are annoyed by pendulous mammæ during lactation, etc. It may, however, be as well applied by using a double-headed roller. In this case, place the body of the bandage in front of the sternum, and carry each cylinder under its respective axilla to form an oblique of the neck and axilla, crossing on the back. After one or two obliques, carry one cylinder horizontally in front of, the other

horizontally behind, the chest, to make a half transverse turn, and then make other oblique and semi-transverse turns of the body till the whole is covered.

11. *The Spica of the Groin, or Figure of* 8 *of the Pelvis and Thigh,*

Requires a single-headed roller eight or ten yards long, three inches wide, and compresses.

Having arranged the dressing, place the initial extremity of the bandage above one of the iliac crests, and make two horizontal turns around the pelvis, in order to fix the point of the bandage, turning from right to left and from before backward, if for the right groin, and the reverse, if for the left. Arriving in front of one of the groins, say the right, descend to the inside of the thigh, between it and the genital organs, and winding round the back part, ascend on the outside to cross the first turn; thence to the ilium of the opposite side; across the back and round the pelvis, to follow the same course until the cylinder is nearly exhausted, when the whole may be fastened by a circular turn of the pelvis, Fig. 57.

Fig. 57.
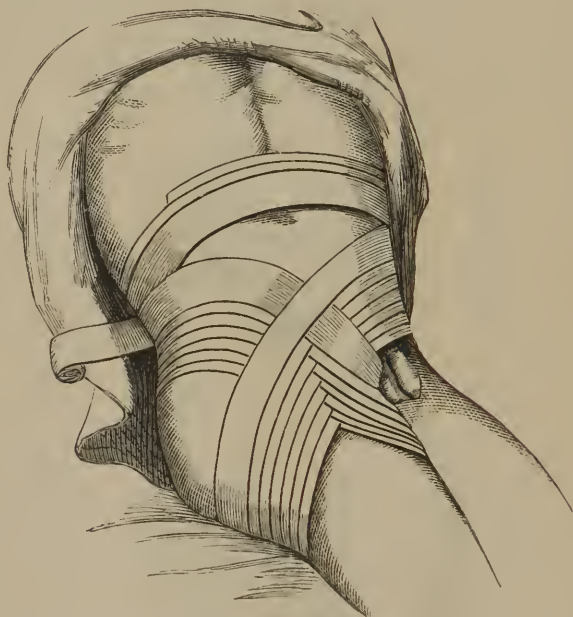


*Use.*—This is an excellent bandage to retain dressings, or make compression on buboes, venereal ulcers, abscesses, etc. situated at the groin.   If it is intended to make a Spica Ascendens, as in Fig. 57, the first turn over the groin should go as far down the thigh as the point to be covered by the bandage, and each turn covering in only one-third of that which preceded it should be made to mount gradually upward.   If, on the contrary, it is wished to make pressure from above downward, the first turn should cross the groin high up, near the abdomen, and each subsequent turn descend, so as to form a Spica Descendens.

This bandage, by covering the groin, is exceedingly useful after operations

for strangulated hernia, or in cases of simple hernia where compression is required and a truss cannot be borne or obtained.

## 12. *The Spica of both Groins*

Is formed by a single-headed roller twelve yards long and two and a half or three inches wide, two horizontal turns of which should be made about the pelvis, going, for example, from right to left and from before backward.    Upon arriving at the second turn, near the left groin, the head of the roller should be made to pass obliquely downward along the outer side of this thigh, and to ascend along its inside so as to cross the first descending turn; after which it may be conducted round the back of the pelvis as far as the right groin, and passing hence along the inner side of this thigh remount on its outer side, and then pass again round the pelvis in front and

Fig. 58.
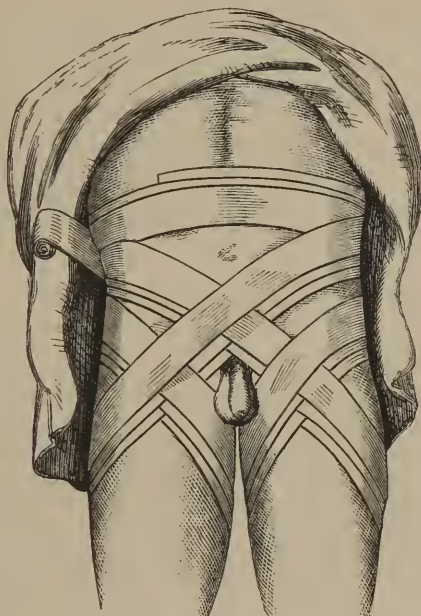


to the left; the head of the roller being made to pursue the course just indicated until only a sufficient quantity remains to terminate the bandage by two horizontal turns of the pelvis, Fig. 58.

*Use.*—Same as the former, but for both groins.

The Spica of both Groins may be very advantageously made with a double-headed roller, if the body of the bandage be applied to the front of the abdomen, in a line with the crests of the ilia, and each head be carried so as to cross behind the back and come round on the groins.    Then let each head descend in the line of the groin, between the genitals, on the inside of each thigh, and pass under, behind, and on the outside, to run one to the right, the other to the left iliac crest, and thence round the back, following the same course.

No bandages can be firmer or simpler than these Spica bandages, when it

is requisite to make firm compression on each groin; but otherwise, as in cases requiring poultices, they will prove inconvenient, from the difficulty consequent on moving the patient in their reapplication.    For a more simple bandage for this purpose, see the Triangular T of the Groin.

### 13.  *The Figure of 8 of the Elbow*

Is made of a roller two yards long and two or two and a half inches wide, by placing the initial extremity on the external and upper part of the forearm, and then passing obliquely over the bend of the arm to the internal tuberosity of the humerus; round, above the olecranon to the external tuberosity; thence obliquely across the front, crossing the first turn like an X, to the inner and upper part of the forearm, and then across the back to the point of departure, to run the same course.  If the arm is much flexed, make one circular turn over the point of the elbow, after the formation of the second figure of 8, Fig. 59.

Fig. 59.

*Use.*—This little bandage, when the arm is either flexed or extended, is very useful in covering in the elbow-joint, and is therefore added to the Spiral of the Upper Extremity for this purpose.    It was also frequently employed to retain the compress used after bleeding.

### 14.  *The Figure of 8 of the Wrist*

Is made like the preceding, by taking one or two circular turns around the wrist, either on its dorsal or palmar face; then, on reaching the cubital side, run obliquely across to the space between the thumb and forefinger, say of the right hand; then obliquely over the palm to a corresponding point on the metacarpal bone of the little finger; thence obliquely across the back of the hand to the wrist-joint; thence make a semi-horizontal turn around the wrist to the ulnar side, and run the same course over again, as seen in the Spiral of the Upper Extremity.

*Use.*—To cover in and compress the wrist-joint.    It is also added to the Spiral of the Upper Extremity, in order to cover in this joint.

### 15.  *The Spica of the Thumb*

Fig. 60.
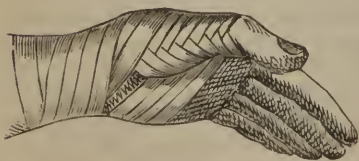
Is made by a roller three yards long and a finger's breadth wide, of which the initial end is fixed upon the wrist by two or three circular turns.  After the last turn, which should terminate upon the radial side, direct the head of the roller from the external to the internal side of the thumb; pass between the thumb and the index finger; return and cross the base of the thumb, and carry it onward again about the wrist.   Repeat these double obliques, and

cover in about two-thirds of each turn by the subsequent one, so as to form a spica, Fig. 60.

*Use.*—This bandage will be found very useful in retaining the phalanx of the thumb in position after a luxation, or for making pressure on the base of the thumb.

## 16. *The Figure of* 8 *of both Thighs*

Requires a few turns of a roller two and a half inches wide, in the ordinary figure of 8.

*Use.*—To keep the thighs together, as after the operation of lithotomy, or after the reduction of a dislocation of the femur.

## 17. *The Figure of* 8 *of the Knee*

Requires a roller two and a half inches wide, of which the initial extremity is to be fastened by one or two circular turns below the knee. Then pass obliquely over the patella, say from the outside to its inside; make a semi-horizontal turn on the back of the thigh, above the joint, to reach the external condyle; go thence obliquely over the patella to the inner side of the tibia; pass round behind it to the head of the fibula, and run the same course again till all is covered, as seen in the Spiral of the Lower Extremity, Fig. 44, page 112.

*Use.*—To cover in the knee or compress the joint. It is also added to the Spiral of the Lower Extremity in order to cover in this joint, especially in fracture of the patella. If it is wished to retain a dressing to the popliteal space, or to treat a fracture of the patella, or hydrops articuli, we have only to reverse the turns of the bandage; that is, start it by circular turns from within outward, and across from below the knee behind, to above it in front.

## 18. *Ribbail's Bandage, or the Spica of the Instep,*

Is a neat bandage, made of a single-headed roller seven yards long and two inches wide, by laying the initial extremity of the roller on the tarsal end of the metatarsal bone of the little toe, if in the right foot, or on that of the big toe, if in the left. Then passing obliquely over the front of the foot to the first joint of the big toe in the right foot, or that of the little toe if in the left, go under the sole of the foot horizontally, in a line with the metatarso-phalangeal articulation, to the outer or inner side of the foot, according to circumstances. From this point make two spiral turns over the front of the foot, which will bring us to the instep on its inner or outer side, and then pass directly to the point of the heel in a line parallel to the sole of the foot, the edge of the roller projecting a little beneath the sole; thence around the heel to come to the instep again, keeping still parallel to the sole of the foot; cross the instep and make another turn similar to the first, which shall embrace the heel and instep; cover in one-third of the preceding turn, and form a spica on the instep, Fig. 61. Continue these turns, gradually ascending, till the foot will hold no more, when we may terminate the bandage by circular turns above the ankle, or else form a spiral up the limb.

Fig. 61.

*Use.*—This forms a most excellent and neat bandage for cases requiring firm compression of the instep or ankle, as in wounds of the anterior or posterior tibial arteries at these points, chronic sprain of the ankle, etc. For it, as well as for many other practical details, we are indebted to M. Ribbail, of Paris, from whose excellent course on Minor Surgery much that is of daily service has been gained.

The Figure of 8 of the Toes, or the Spica of the first toe, is so precisely similar to such bandages in the fingser and thumb, as not to require a description.    In applying any of them make a few circular turns of the instep instead of the wrist, and then proceed exactly as in the hand.

### V.—OF THE KNOTTED BANDAGES.

These bandages, named from their forming a knot like that known as the Packer's Knot, are formed by double-headed rollers, and intended to make firm compression on particular points, as on bleeding vessels, etc.    The only one of importance is that for the head, which is used to arrest hemorrhage from the temporal artery.    Under this class we may, however, with great propriety include all those which are terminated by bow-knots, as the 8 of the Elbow after bleeding at the bend of the arm ; that of the Ankle ; as well as the Sailor's Knot, Clovehitch, and others employed in the treatment of dislocations.

### 1. *The Knotted Bandage of the Head*

Is made of a band five yards long and two inches wide, rolled up into two heads of unequal size, one being a fourth larger than the other.    In applying it, place the body of the bandage over the graduated compress covering the wounded artery, and conduct the two heads, one before and the other behind, to the opposite temple, where they should be turned on each other, in order to return to the point of departure.    Now give them a turn or twist, so as to enable one to pass over the summit of the head, and the other underneath the chin, to the sound side.    When they meet, turn them as in the first instance, and from thence conduct them in the same course to the point of departure on the wounded vessel.    A second turn or twist being effected, let them pass for the third time to the opposite temple, then for the third time return horizontally, and knotting them firmly, let each knot be placed behind the one first formed ; the bandage being then conducted, one head over the vertex and the other underneath the chin, is terminated by a few circular turns of the forehead and occiput, Fig. 62.

Fig. 62.



*Use.*—For arresting hemorrhage of the temporal artery, or any of its branches.    It is, however, a painful bandage, in consequence of the compression made on the lower jaw, or on the point of injury.    Sloughing of the scalp has also been known to follow its injudicious application.    It therefore requires constant attention, lest it remain on too long or be too tight.    It is usual to close the opening in the vessel first with a piece of adhesive plaster, as will be seen hereafter when treating of arteriotomy.

## VI.—OF THE RECURRENT BANDAGES.

The **Recurrent Bandages** are formed by convolutions or parabolic and recurrent turns, which make a kind of cap for the parts to which they are applied. Unlike most caps, however, they are exceedingly apt to become relaxed. Although very neat in their appearance, these bandages require more watching than is convenient, consequently they are often supplanted by other dressings. When required, they may be made either with the single or double headed roller ; but from the difficulty of removing the latter without its coming off in mass, and thus perhaps bringing ligatures, etc. altogether, those formed by the single-headed roller are most generally employed.

### 1. *The Recurrent of the Head*

Is composed of a single-headed roller five yards long and two inches wide, the initial extremity of which is placed on one side of the head on a line with the supra-orbitary ridge, while the cylinder is carried two or three times round the head by circular turns. On coming to the middle of the forehead in the second turn, the bandage should be reversed and the reverse confined with one hand, while the cylinder is carried over the top of the head in the line of the sagittal suture, to the occipital protuberance, reversed here, and there held by an assistant. Then coming obliquely over the head to the forehead, make another reverse to go to the occiput, each turn covering in one-third of the preceding one, and continue thus till the horizontal turn

Fig. 63.
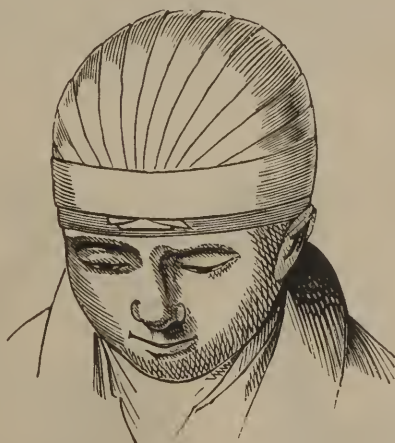


on the right or left side of the head is reached. Cover the opposite side by similar turns, seeing that each reverse comes to the same point, in front and behind, and terminate the bandage by circular turns firmly applied around the reversed turns, as in Fig. 63.

*Use.*—To retain dressings to the head, as in the application of blisters to the scalp—in erysipelas, in wounds, and in other injuries of the scalp, etc. But care must be taken not to draw the horizontal turns too tight, lest, as in the case related by Percy, ulceration or gangrene of the scalp ensue.

## 2. *The Recurrent of the Head,*

As made by a double-headed roller, of the ordinary width and length of



Fig. 64.

a roller for the head, requires that the body of the bandage be placed upon the occiput or forehead, so that, after two or three circular turns, the rollers may be made to intersect each other upon the occiput. One of them is then to be reflected over the vertex to the forehead, while the other continues in a circular course on the side of the head. Then, crossing each other upon the forehead, the first head is carried obliquely backward to the occiput, and reflected by the side of the other, while the last, *a*, is continued in a circular direction. The first, *b*, being again brought over the head, from behind forward, is to be carried in this way backward and forward, in reverses, till the head is entirely covered, Fig. 64.

*Use.*—This, like the previous bandage, serves to confine dressings upon the head, but is now rarely employed, for the reasons there stated. The ancients, by its means, exerted compression on the heads of hydrocephalic patients.

## 3. *The Recurrent of Amputations*

Embraces two varieties, according as it is made with a single or double headed roller. As, however, it is difficult to remove the latter, I shall only give the application of the former, which is made of a single-headed roller, of different lengths, according to the volume of the stump to be covered, but generally two or two and a half inches wide.

Fig. 65.
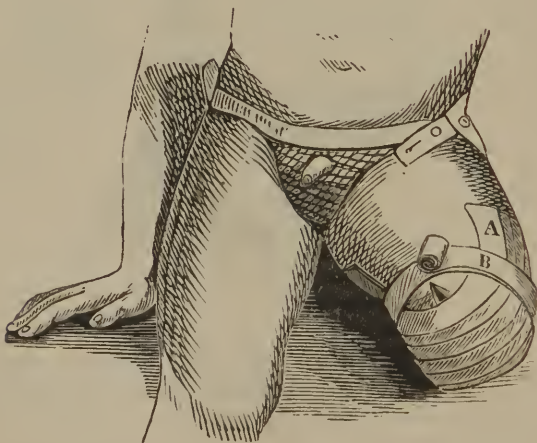


The position of the patient, for the application of this bandage, should be such as is most easy to him—the stump being well supported and the integuments pushed over the end of the bone by assistants.

Then, having arranged the Maltese Cross and other dressings, place the

initial end on the surface of the limb three or four inches above the extrem-
ity of the stump ; make two or three circular turns to fix it, and, on coming
to the central point of the under portion of the limb, reverse the roller, so
as to run up in front of the stump and over its upper surface to a point, A,
Fig. 65, four or more inches above its extremity.    Fix all these reverses by
the fingers of one hand, if the size of the limb will permit ; if not, employ
an assistant for the reverses on one side, and continue to make them till the
whole face of the stump is covered, when the bandage is to be terminated
by spiral reversed turns, which, starting from the circumference of the stump,
B, run up a few inches above the first turn of the bandage, and are there con-
fined by a pin.    If there is a tendency to spasm of the stump, the ends may
be carried on and made fast to the pillow or bed on which the limb lies.
But care is requisite not to draw the recurrent turns at A too tight, lest,
by compressing the soft parts against the point of the bone, they cause
irritation and spasm, and create the jerking that is so great an annoyance.

The figure also shows the application of a Suspensory Bandage to the
Testicles.

## SECTION III.

### OF THE COMPOSITION AND APPLICATION OF THE COMPOUND BANDAGE, OR BANDAGE PROPER.

It has been already stated that usage having justified the application of
the term Bandage to what should be strictly known only as the Roller, the
Bandage Proper would be described under the head of Compound Bandages.

Compound Bandages include a considerable number of the most useful
means of retaining dressings, and as their application is generally simple,
though their composition is sometimes a little complicated, attention will be
mainly given to the latter, believing that, after they are constructed, their
application will be easy.

#### I.—THE T-BANDAGES.

##### 1. *The Single T, or Crucial Bandage,*

Named from its shape, is composed of *a horizontal portion* sufficiently
long to go entirely round the part to be covered, and yet leave enough to



Fig. 66.
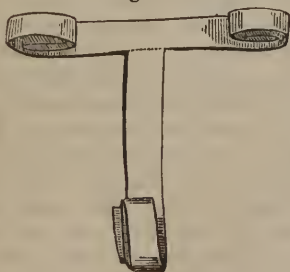


Fig. 67.

make a bow-knot, and of *a vertical piece* which is half the length of the
horizontal one, and generally attached firmly to its middle, so as to form

the perpendicular portion of the T, Fig. 66.   Each portion should be rolled into a cylinder and confined by a pin previous to its application, in order to insure its smoothness when applied.

The vertical portion varies considerably in its shape and length.   Sometimes there are two vertical pieces, as in the Double T ; and sometimes it is three or four inches wide, and slit into two tails to within a short distance of the horizontal band, as in Fig. 67.   In others a triangular piece is added, etc., as will be seen hereafter in the special applications of this bandage.

## 2. *The T-Bandage of the Head*

Requires a horizontal piece of bandage two yards long and two inches wide, upon which, at about one-third of its entire length, a strip half a yard

Fig. 68.



long and of the same width is stitched at right angles, to form the vertical portion.   The bandage then being rolled into two heads, the surgeon places himself before the patient and applies the body of the bandage to the middle of the forehead, with the edge corresponding to the vertical portion of the bandage uppermost, in order that the latter, after traversing the vertex, may hang loosely down the nape of the neck.   Then, passing the remainder of the horizontal portion along the temples to the occipital region, he crosses the vertical strip, which should be immediately reflected upward and secured upon the brow by the last turns of the horizontal. A double T may be formed by stitching a second strip upon the transverse portion of this, at a convenient distance from the first.

*Use.*—This light bandage may be used for retaining dressings to the scalp, when the vertical band is so placed that it may run over the point to be covered.   Where the dressing is small, it is preferable to the recurrent bandage of the head, as it is not so heating.

## 3. *The T-Bandage of the Ear*

Is made of a horizontal portion two yards long, of a vertical one a half

Fig. 69.



yard in length, and of a piece of linen of the shape and size of the external ear, or one with a slit in it sufficient to permit the ear to pass through, as in Fig. 70.   Sew the horizontal band to the summit of the ear-shaped piece of muslin, and attach the vertical one to the opposite portion, or that corresponding with the soft part of the ear, Fig. 69.   Then place the circular band around the head above the ear of the affected side, and the muslin over or close behind the ear, and carry the vertical band under the jaw and up on the opposite side, where it will be confined by the horizontal turns, Fig. 70.
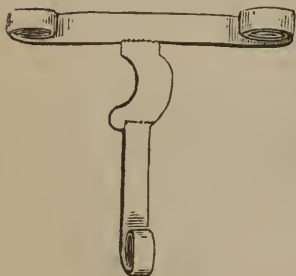
*Use.*—This modification of the T is an excellent bandage for retaining dressings to or behind the ear, especially the latter.   Every one has felt the

tuberance of its side, and down to near each mastoid process, under the horizontal band. Turn them over this to come upward, and fix them by bringing the remains of the horizontal band, from its crossing on the nape of the neck, round the forehead; where they may be fastened either by a knot or a pin, Fig. 71.

*Use.*—This little bandage is very useful in retaining dressings to the upper lip and root of the nose, especially in cases of fracture of the bones of the latter, or in epiphora or fistula lachrymalis, as it is easily renewed, and does not interfere with the use of the eyes, nose, or mouth, while it acts on the part nearly as firmly as adhesive plaster, without being liable to its objection.

The single T-bandage of the nose is also a useful mode of retaining dressings to its surface; but as it is much improved by the addition of a suspensory, it will be treated of under the latter bandages.

## 5. *The Double T of the Chest*

May be formed of a broad piece of muslin, of a proper width and length, according to the size of the patient, and of a band two feet long, split nearly to the end; or of two distinct bands of the same length, which are to be attached to its upper edge. Then pass the muslin around the chest, and, bringing the two extremities forward, stitch them to the first piece. Or the bands themselves may be brought forward over each shoulder and secured in front, so as to form shoulder-straps, Fig. 72.

Fig. 72.
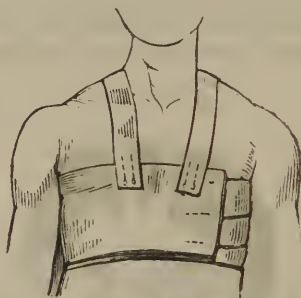


*Use.*—In cases of fractures, to compress the ribs or to retain dressings to the back. Frequently buckles and straps are fastened to the ends in front, and buttons to the upper edge to receive the shoulder-straps; these make the bandage much firmer, but also a little more complicated in its composition.

## 6. *The Double T of the Abdomen*

Consists of a piece of muslin, to one of the borders of which are stitched, at equal distances from its centre, two narrow bands half a yard long, to serve for thigh or perineal straps. They should be attached sufficiently apart to correspond nearly with the line of the great trochanters.

In its application, the horizontal portion of the muslin should be placed around the pelvis, and the extremities brought round on the abdomen, where

they overlap and pin. The vertical bands should then be conducted from behind forward; crossed under the perineum, and fixed upon the fore part of the horizontal band, as in Fig. 73.

Fig. 73.
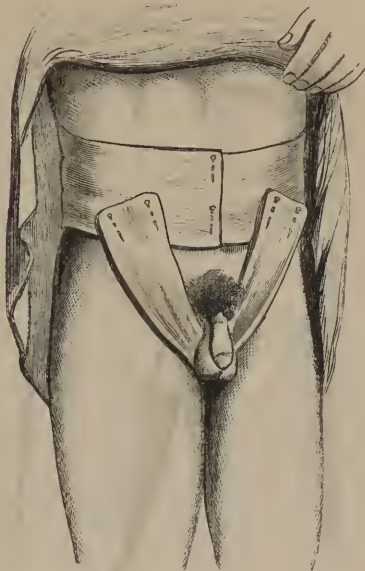


*Use.*—To retain poultices or other dressings to the abdomen; to exert compression on this part after the operation of paracentesis, or after delivery, although its application then belongs rather to the accoucheur than to the surgeon.

This is the reverse of the T of the chest, the vertical bands being made to pass under the pelvis instead of over the shoulder.

### 7. *The Triangular, or Compound T of the Groin,*

Requires a piece of muslin five inches wide at its base and ten inches long, made of a triangular shape, in order to correspond with the upper and internal part of the thigh. To the base of this sew a horizontal band about two yards in length; and to its summit a vertical one three-quarters of a yard long.

The dressings being then placed on the part, the extremities of the horizontal band are carried round the pelvis on either side as far as the sacrum, whence they are returned and tied in a bow above the pubes; the vertical band and the triangular piece being now passed down between the thigh and scrotum, the former comes up over the outside of the thigh and is attached to the transverse portion of the bandage, Fig. 74.

*Use.*—To retain dressings upon the groin of a patient confined to bed, as in poulticing buboes, or after operating for hernia. This bandage will be found to be one of the best bandages that we can employ for retaining dressings to the groins in cases where it is requisite to renew them frequently, and especially when it is difficult to move or raise the patient; it being only

necessary to untie the vertical band and draw it from under the thigh, in order to lay open the whole groin to our view, which may be readily done without the least movement on his part.

Fig. 74.
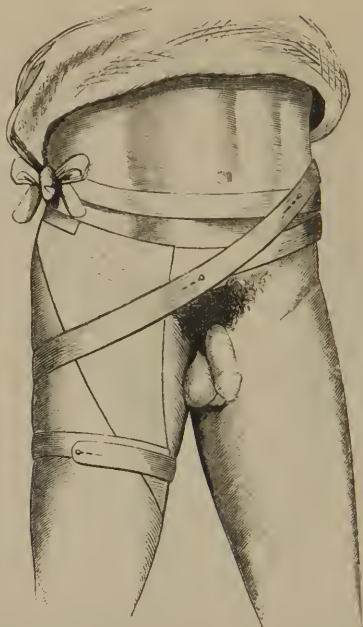


## 8.  *The Double T-Bandage of the Buttock*

Requires a roller two yards long and three inches wide, and also two vertical bands each three-quarters of a yard in length and two inches broad stitched to it at right angles, at about one-fourth of its length. Then the horizontal band being placed around the pelvis, so that the vertical bands may correspond to the median line of its posterior face, its extremities are fixed with pins, and the vertical bands brought under the perineum and fastened to its front portion.

Fig. 75.
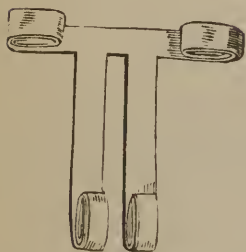


*Use.*—This is the common double T-bandage employed to retain dressings to the perineum, anus, or vagina, in cases of piles, prolapsus ani, and fistulæ. Instead of the two tails, that formed by slitting the single T may be used, as seen in Fig. 67.

## 9.  *The T-Bandage of the Hand*

Is composed of a narrow bandage or piece of tape one inch wide and a yard long, and of a second piece one yard long. Sew the longest piece to the other, in order to form the vertical portion of a T, and place the horizontal band on the back or front of the wrist, so that the vertical band may

present to the fingers.  Carry the latter portion over the back or front of the hand, over the interdigital space of the first and second finger ; come up again to the wrist, and surround it by a half turn of the horizontal piece ; reverse the first over the latter to return to the space between the middle and third finger, retaining the dressing, and coming up to the wrist again ; surround it again by the horizontal band ; reverse the vertical one in order to pass between the ring and little finger, and on the outside of the latter to the wrist, where it may be fastened by the turn round the joint.

*Use.*—This is a very light bandage for retaining dressings to the inter-digital spaces as well as the body of the hand, and offers a substitute for the gauntlet or demi-gauntlet, before seen.

### 10.  *The Perforated T of the Hand*

Is made of a two-inch roller one yard long, and of a piece of muslin of the breadth and twice the length of the palm of the hand.  Fold the muslin on itself in its length, and cut in it four circular openings, as at D, about three lines apart, to corre-spond with the fingers.   Then sew one of its extremities at right angles to the roller or horizontal band, as in Fig. 76.



Fig. 76.

Pass the fingers through the openings, and stretch the muslin over the back and front of the hand, confining the loose end by a few circular turns of the roller around and above the wrist.

*Use.*—Same as the above.

The T-bandages of the feet, being similar in their formation and applica-tion to those previously explained, do not require a special description.
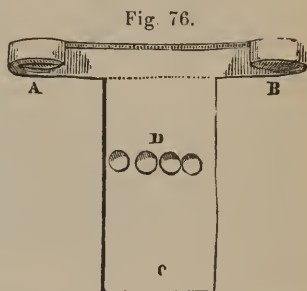
### II.—OF THE INVAGINATED, OR SLIT AND TAIL BANDAGES.

Of the **Invaginated Bandages** there are two kinds—one, in which the same roller is formed at one end into strips or tails, and at another part into slits or button-holes ; the other, in which two distinct bands are thus prepared. In either case, the tails of one piece are passed through the openings in the other, and, by acting on compresses, approximate all the portions under them.    The first is employed to assist the union of longitudinal, the second to approximate transverse wounds, as well as for the treatment of certain fractures.   When wounds are deeply seated, the application of adhesive strips only causes apposition of the surface and leaves the parts below separated, so that as the secretion of pus continues, a bag or cyst is formed, from which the matter cannot escape except by burrowing beneath the tissue. When, also, divided parts have a tendency to contract, they very frequently tear out the stitches, and in both these cases the invaginated bandages will be found exceedingly useful.

### 1. *The Invaginated Bandage, for Vertical Wounds of the Lip,*

Is composed of a roller two or three yards long and one inch wide, rolled into two heads, and of two small compresses about two inches square, which are to be placed on the cheeks, near the angle of the mouth.

In applying this bandage, place the body of the roller on the forehead, or on the nape of the neck near the occiput, and carry each cylinder round under the lower part of the ear, over the malar bones, and over the compresses to the lip. Then slit in one bandage a hole large enough to admit the other roller; pass this through and draw upon each; carry them both round to the nucha, and then run the same course till the parts are well supported and covered in, as in Fig. 77, terminating on the forehead.

Fig. 77.



*Use.*—In vertical wounds of the lip, where other means are not at hand, or to support the hare-lip suture and prevent its cutting out. By the pressure which it makes on the lip, it is also useful in arresting hemorrhage from the coronary arteries.

## 2. *The Invaginated Bandage of the Body*

Is composed of a double-headed roller, of a length sufficient to go several times around the body, and of two compresses of the length of the wound. The body of the bandage being placed on the back, and the heads brought round under each axilla, and over the compresses on each side of the wound, make a slit in the roller of one side, and pass the cylinder of the other side through it, by which means the wound will be well closed. Continue to do this as often as may be necessary.

*Use.*—To unite longitudinal wounds of the chest or abdomen, or to support the parts after the removal of the breast.

## 3. *The Invaginated Bandage, for Longitudinal Wounds of the Extremities,*

Is formed of a piece of linen, sufficiently long to make three or four turns of the part to be treated, and of a breadth corresponding to the length of

Fig. 78.



the wound. Divide this piece so as to form three tails, long enough to embrace three-fourths of the part wounded. At a convenient distance farther on, make three longitudinal perforations, opposite to and of the same

breadth as the tails. Then roll up the remainder of the band, and make two graduated compresses of such a size as may be required by the wound.

If the bandage is to be applied to the upper portion of a limb, its lower part should be first covered by the turns of a spiral bandage, after which the undivided portion, or that situated between the tails and the slits, being applied upon the part which is exactly opposite the wound, and the graduated compresses placed on each side of the latter, at the distance of about three or four fingers' breadth from its edges, the tails are to be passed through the corresponding slits, and the edges of the wound united by drawing the extremities of the bandage in contrary directions; then secure the tails by turns of the remainder of the roller, or by those of a spiral one.

*Use.*—This bandage may be used in deep-seated wounds of the extremities as an adjuvant to adhesive strips, as it unites the deep-seated parts as well as the skin, thus preventing any distention of the inside of the wound, or the formation of an abscess.

4. *The Invaginated Bandage, for Transverse Wounds of the Extremities,*

Will be referred to under the head of Fractures of the Patella, and is shown in Fig. 79.

Fig. 79.
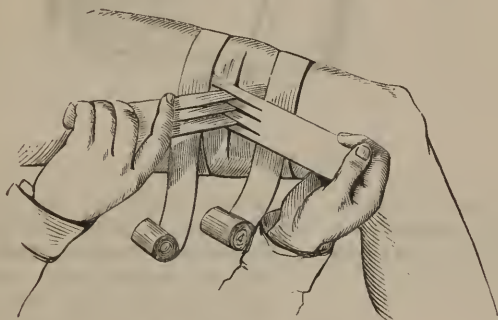


5. *The Uniting Bandage, for Transverse Wounds of the Neck,*

Is very useful in cases of maniacs, or those who have attempted suicide by cutting the throat. It requires a single-headed roller four yards long; a piece of bandage one and a half yards long and three inches wide; a bandage for the chest with perineal bands.

Fasten the bandage on the patient's head by a few turns of the roller, and fasten, at the same time, the band by its centre upon the top of the head. The broad bandage being then applied round the chest, and pinned, secure the head by a few more circular turns of the roller, after which its extremities are to be firmly fastened to the fore part of the body bandage, the head being forced down on the chest so as to bring the chin near the top of the sternum, Fig. 80. It is important that the head should be well bent on the chest, otherwise the patient, by increasing the flexion, may readily loosen and derange the bandage. If the edges of the wound are likely to overlap by too much flexion of the head, a strip attached to the band on

the back of the head, and also to the band around the chest, will obviate this evil, and render the dressing perfectly firm.

Fig 80.



III.—OF SLINGS.

**Slings** are light bandages of great simplicity, and very useful in retaining simple dressings, in consequence of their not oppressing the part to which they are applied.  They are formed of pieces of muslin of various lengths and widths, split at each extremity into two or three tails to within a few fingers' breadth of the centre, as seen in Fig. 81.  Slings are also occasionally formed of a piece of muslin of a size sufficient to cover the part to which the dressing is to be applied, to each end of which bands are attached to serve as tails; thus making it resemble the ancient slings employed for hurling stones, whence their name.  In using the sling, the body or central portion is first applied to the part, and then the tails are carried round and confined by knots or pins.
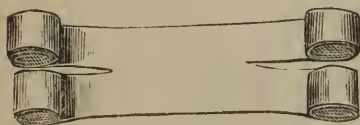
Fig. 81.



1. *The Sling of Six Tails, or the Bandage of Galen,*

Is made of a piece of muslin a yard long and a quarter of a yard wide, split at each end into three tails to within three fingers' breadth of the centre, the central tail being somewhat broader than the others.  The body of the sling being then placed on the top of the head, the central tails are passed along the ears and secured underneath the chin, the tails being

smoothly folded, so as to adapt them better to the lower jaw. The frontal
tails are then directed from the anterior to the posterior part of the head,

Fig. 82.



where they overlap each other, while the occipital tails are brought forward
and secured by pins, Fig. 82.

*Use.*—To retain large dressings, as poultices, etc., to the whole scalp.

### 2. *The Sling, or Four-tailed Bandage of the Head,*

Requires a strip of muslin a yard long and six inches broad, split at each
end to within three fingers' breadth of the centre. When the wound is on
the forehead, the body of the sling is applied there, and the two anterior
tails carried posteriorly and fixed at the back of the head, while the pos-

Fig. 83.                                        Fig. 84.



terior tails are fastened either upon the forehead or beneath the chin, Fig. 83,
as the surgeon may consider most convenient.

In order to confine a dressing upon the summit of the head, the posterior

tails should be brought down and secured beneath the chin, and the anterior tails, after being carried to the nape of the neck and crossed, should be fixed before the throat.

In applying a sling to the **Nape of the Neck**, the upper tails are to be conducted over the forehead, from whence, after being made to cross each other, they are returned, and fastened at the occiput, the lower tails passing round the front of the neck. This forms the sling of the neck, as seen in Fig. 84.

Fig. 85.



*Use.* — These bandages are very simple and convenient, and of great utility in wounds of the head or neck, as they can be applied over every point of this portion, by merely changing the direction. On the neck, especially, the sling forms an excellent bandage for retaining blisters, setons, etc.

### 3. *The Sling of the Chin*

Requires a piece of muslin six inches by four, slit at each extremity for two inches, to each of which is to be attached a piece of tape or bandage, one yard long. In its application, place the body of the sling under the jaw, so that the chin may be exactly in its centre, carry the two posterior tails up over the cheeks and vertex to the mastoid process of each side, where an assistant should hold them. Then turn the anterior part of the sling and the anterior tails upward in front of the chin, and carry the front tails under each ear to the nape of the neck; cross them on the neck to come forward to the forehead, where they may be knotted, after the tails from the mastoids have been carried under their posterior portion, Fig. 85.

*Use.*—In fracture of the jaw without displacement, and to retain dressings to the front of the chin, or under the jaw.

### 4. *The Sling of the Face, or Mask,*

Is made of a body-piece to fit the face, and of four tails to hold it in its position.

In shaping the central portion, fold a piece of muslin, nine or ten inches square, on itself, so as to form an oblong square. Place this on the face so that the double side may correspond exactly with the central line of the face, and mark on it a line, A B, Fig. 86, and a circular opening, C, for the eyes. Make also a semicircular, F, for the mouth, and a small transverse cut, E, to correspond with the end of the nose. Then cut off the angles, A H and I K, so as to give an oval form, and cut out at G two triangular pieces, the edges of which are to be sewed together to adapt it to the pro-

Fig. 86.
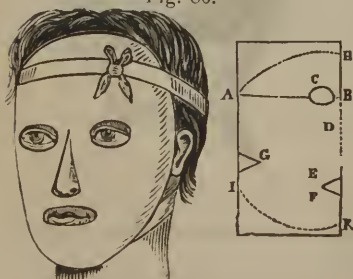
jection of the cheek-bones. Attach two vertical tails at G, and two horizontal ones at A; then open it out and make a vertical cut, D, from the transverse line at the point of the nose, up to the point between the two eyes. Apply this to the face and carry the upper tails to the occiput; cross them; come around on the forehead, and carry the horizontal tails to the neck, in order to return to the forehead or chin, as in the figure, on the left side of the cut.

*Use.*—To retain dressings to the whole face, in cases of burns from blasting rocks, gunshot wounds, erysipelas, small-pox, etc., in all of which it will be found to be a most useful bandage.

### 5. *The Sling of the Mamma*

Is made of a square piece of muslin sufficiently large to cover in the breast; slit for one inch and a half on each of its four sides, and of four bands sewed to its four angles. These bands must be long enough to go round the chest. Now while an assistant supports the breast or retains the dressing, place the body of the sling on the part, and carry the lower tails under each axilla. Come round in front of the chest, and carry the upper tails on each side of the neck, over the shoulder, and fasten them to the horizontal band, Fig. 87.

Fig. 87.
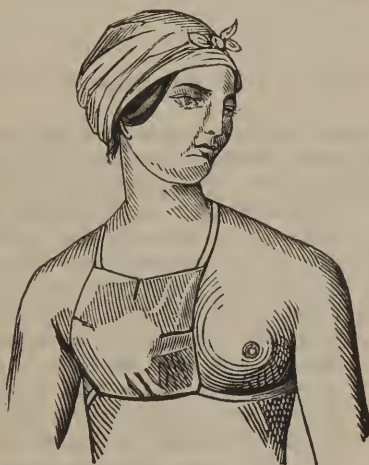


*Use.*—To retain a poultice or other dressing to the breast, or to support it, as in cases of cancer, etc.; but if compression is required, the *Crossed of the Breast* answers better.

This, or the **Four-tailed Sling,** may also be usefully employed in retaining dressings to the point of the shoulder, the elbow, back and front of wrist, or to the heel and instep. In either of these cases, place the point to be covered in the centre of the body of the sling, and carry the tails round the part, so as to fasten the bandage firmly.

### IV.—OF SUSPENSORIES, SHEATHS, AND LACED BANDAGES.

**Suspensories** are bags of various sizes, intended to support depending parts, retain dressings to them, or cover such portions as would not otherwise receive a bandage. In all such cases they will be found of great service, and as their manufacture is simple, it is surprising that they have not obtained a more general use. As adapted to the nose, etc. they can be highly recommended to those requiring a complete bandage for such parts.

#### 1. *The Suspensory of the Nose*

Is used to retain dressings to the whole of this organ, and is composed of



Fig. 88.

a triangular piece, cut from an oblong square, as in the dotted lines B C and C D, Fig. 88, to the sides of which are attached the vertical and horizontal bands of a single T. In applying the bandage, place the nose within the suspensory, and carry the vertical band over the head to the neck, confining it by the horizontal bands, which are crossed on the nucha; brought up on the forehead, and fastened as seen in the cut. The opening at A is to suit the position of the nostril.
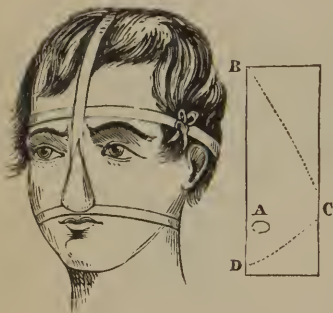
#### 2. *The Suspensory, or Bag-truss of the Scrotum,*

As found in the shops, consists of a net-work bag, and bands to fasten it, Fig. 65; but as this cannot always be had, its place may be readily supplied by one formed as follows, the application of both being the same:



Fig. 89.
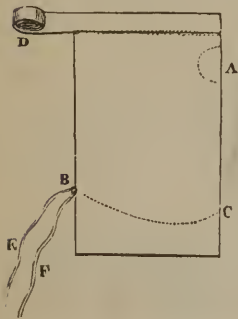
Fold a piece of muslin on itself, of a size to suit the part, say six inches by four, and cut out an opening, A, for the penis, and a curvilinear portion according to the dotted line, B C, Fig. 89. Sew the divided edges of this curved portion together, and attach a horizontal band, D, to the upper part, and two vertical ones, E F, to the lower posterior angle, making an opening or button-hole in the end of each band. Sew on two buttons to the horizontal band to serve for the attachment of the vertical or perineal straps. Then the penis being engaged in the opening, A, and the scrotum perfectly enveloped, the belt should be carried round the pelvis, returned in front, and tied above the pubes. The two vertical bands are then made to ascend from the perineum along the inferior border of the glutei muscles, and buttoned to the belt in front, Fig. 65, page 128.

*Use.*—To support and confine dressings upon the scrotum, or to serve as points of attachment to other apparatus, or for the treatment of swelled testicle, hydrocele, and irreducible scrotal hernia. This bandage should also always be worn during the treatment of acute gonorrhœa, as it diminishes the liability to epididymitis.

## V.—SHEATHS

Are coverings intended to retain dressings to the penis, fingers, and toes. They are the finger-stalls of domestic use, and employed daily by every one who has cut a finger. A very useful application of them by the surgeon can be made in cases of gonorrhœa, as when made of large size they will readily retain a portion of charpie on the head of the penis, and by absorbing the discharge prevent its staining the linen. They are also very useful in retaining poultices to the head of the penis, or dressings to chancres, etc., in consequence of their not being easily deranged by erections. The band in such cases passes around the hips, as it does around the wrist when applied to the finger.

## VI.—THE LACED, OR BUCKLED BANDAGES,

Are so named from the manner in which they are confined to the part. As they are usually obtained from the glovers or bandage makers, they will only be referred to in passing. Their application being simple, and the discovery of them somewhat ancient, their use is generally understood.

### 1. *The Laced Bandage, for the Knee,*

Is made of any elastic substance, such as buckskin or kid, lined with caoutchouc, or of silk and gum-elastic woven together, and laced or not at the side. It is sometimes employed where constant compression is required, as after dislocations of the patella, and in chronic enlargements of the joints. When wanted, they should be made to order, as their utility depends on the accuracy with which they fit. They may be obtained of the cutlers or druggists generally.

### 2. *The Laced Stocking*

Is employed in the treatment of varicose veins, for the support of tender and extensive cicatrices of the leg, and in old ulcers, etc., being occasionally preferable in these cases to the ordinary bandage, as it presses uniformly throughout its whole extent; may be readily applied by the patient, and worn under a boot. Where this bandage cannot be obtained ready made, slit a common strong cotton stocking down the side, and hem in on each edge a *very thin* slip of whalebone. Then work a few eyelet holes along the edges behind the bones, as in the corsets of the female, and fasten it up by lacings, Fig. 90.

Fig. 90.

Fig. 91.





### 3. *The Laced Gaiter, for the Foot,*

Is constructed, like the knee-cap, of buckskin, cloth, or kid, and laces along the outside of the foot and ankle, as in that daily worn over a shoe. It serves admirably for supporting the parts after sprains or weakness of the lower portion of the leg and foot; in the cure of old ulcers on the malleoli, and of œdematous swellings of the ankle and foot generally, Fig. 91.

# CHAPTER IV.

## OF THE HANDKERCHIEF SYSTEM OF M. MAYOR, OR THE SYSTEM OF PROVISIONAL DRESSINGS.

In 1838, M. Mayor, a surgeon of Lausane, Switzerland, introduced to the attention of surgeons the use of pocket-handkerchiefs or similar pieces of muslin, as a useful substitute for the ordinary Roller or Bandage, claiming that "the more readily we can procure such means of bandaging, the greater also their simplicity and uniformity, the less embarrassing will it be for a surgeon to fulfill his duties, the less perilous will be the progress of the treatment, and the less doubtful the chances of its termination, especially when practicing among the poorer classes, in the country, in thinly-peopled districts, or in the army or navy, where hospital stores have failed or are rapidly diminishing." In doing this, he made such a simplification of surgical apparatus that under any, even the most disadvantageous circumstances, relief may be afforded, and a plan of cure employed as safe and as commodious as that generally recommended.

The principle laid down is, in his own words, "to reduce as much as possible all kinds of apparatus to their most simple forms, by making them dependent upon particular and uniform ideas; in order that the parts of such apparatus, or the material objects of any dressing, may be so common, and of such a nature, as to be met with under every or nearly every circumstance; and that, in the absence of a scientific man, they may be applied with facility by the first comer, after very little instruction. In other words, to find out a means, simple, easy of application, ever at hand, or at least always to be obtained, which may replace lint, compresses, bandages, and ligatures, such as surgery ordinarily requires for the various species of dressings."*

This principle, which is certainly correct, is one that Mayor has the credit of prosecuting to perfection, although for many years exposed to the sneers and ridicule of his professional brethren. As his plan of treatment is now better known, his system is meeting with the respect to which by its merits it is entitled.

As it would be impossible at present to treat of all this surgeon's objections to the common modes of dressing and bandaging, or give the fullest details of his method of treatment, reference will only be made to the more interesting portion of his matter, believing that many valuable hints may be derived from it, even by those who would not feel inclined to abandon altogether the older and more scientific methods employed in the treatment of surgical accidents.

It has not been M. Mayor's object, as he expressly says, "to banish wholly

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* Nouveau Système de Deligation Chirurgicale, Paris, 1838, p. 16, Introduction. Troisième edition, avec un Atlas.

from the domain of surgery, charpie, lint, bands, etc., notwithstanding that such would be rigorously possible; but he has been so often struck with their abuse and their almost exclusive employment, that he could not forbear exposing their numerous inconveniences in practice, and endeavoring to establish his own motives for what he admits to be their *quasi exclusion*."

The principal objection which he makes to the common bandage "is in relation to its frequent absence in time of need; the occasional impossibility of procuring it, and the serious inconveniences with which its application may be attended when performed by unskillful hands; for even under the best opportunities the habit of applying a bandage requires time, and is susceptible of being speedily lost. Bandages, also, are liable to become relaxed, easily deranged, and *corded*, thus inflicting injury in a variety of ways, and rendering their frequent reapplication a matter of essential necessity; their diversity of length and breadth is also more or less perplexing to some; to roll them well is troublesome; and when to these well-founded objections to their exclusive employment is added the difficulty of having them always clean and neat, as well, also, as the little care that patients take of them when they are not absolutely wanted, it must be evident that some other means are requisite to rid the surgeon of so many causes of vexation and embarrassment; and that when such are found, they must be hailed by the profession with something like satisfaction.

"Now, all the inconveniences here spoken of may be avoided, and all the good desired obtained, from a bandage either of the original form of a cravat or pocket-handkerchief, or of the principal modifications of this, adapted to the nature of the case." Mayor makes four modifications of a handkerchief, or cravat-shaped piece of linen, subservient to all the objects of a bandage; such as the *Oblong*, the *Cravat-shaped*, the *Triangular*, and *Cordiform* handkerchief, the latter being only employed as a substitute for a cord, or strong tie, in certain cases.

None of the objections made to the ordinary bandage can, Mayor thinks, be applied to the Handkerchief. "It is found everywhere, and under every circumstance; is adapted to its purpose; is not liable to become relaxed or otherwise deranged, and cannot become corded; it is easy to fasten; may be changed and reapplied with the utmost promptitude, as a single circumvolution of it is often equal to a multitude of turns of the common band; is also more economical, as it may always be washed and made ready to apply to other than to surgical purposes; the thickness and breadth can be varied at will; in short, it is so much the more perfect as it forms one whole, while each turn of a common band, being considered as a piece apart, the derangement of one necessarily entails the derangement of all the rest."

It is not, however, pretended by him that this new description of bandages can supply, *completely*, the place of common rollers; for, as he justly observes, "there are cases which require a methodic compression of a certain energy, such as affections of the mammæ and of the extremities. But as these are comparatively rare, handkerchiefs should be employed as a general rule, while rollers should form but the exceptions."

In the application of the handkerchief, or triangular piece of linen, Mayor commences at the head, and then, as in the arrangement in the following pages, proceeds regularly to the trunk and extremities. In pursuing this course he designates his handkerchief bandages by certain names, which may at first sight appear to be unnecessary and pedantic. But when it is recollected that the arrangement of the name shows the course to be pursued in the application of the handkerchief, it will be seen that the name is a matter of considerable importance, and that it aids us materially in their application; thus, in the *Fronto-Occipital Triangle*, we have the shape of the handkerchief,

and the statement of the fact that it is to be first applied to the forehead, and then to pass to the occiput; so in the *Fronto-Cervico-Labialis* cravat, or the *Occipito-Sternal*, we know that the cravat should cover, first the forehead, then the neck, then the lip, while the other should start at the occiput and end at the sternum.

### THE HANDKERCHIEF, OR SQUARE LINEN.

A handkerchief may, according to Mayor, replace all the bandages which have been before described. In its dimensions, as well as in the tissue composing it, the surgeon must be regulated by the size of the part to which it is



Fig. 92.
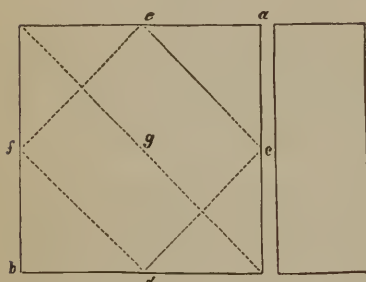
to be applied, or the circumstances of the moment. It is, therefore, a matter of indifference whether it be made of silk, cotton, or linen. If it is too short to go round a part at the time of its application, it may be easily lengthened by attaching to the extremities two pieces of tape or ribbon.

From this original piece Mayor forms all the others, by folding it according to the dotted lines of Fig. 92; thus, if the four angles are folded into the centre, *g*, it makes a smaller square, which may be again reduced by repeating the process. In this shape it answers very well for the application of warm fomenting poultices, which may be thus easily retained between the two layers of the handkerchief. If the square handkerchief is folded from angle to angle it forms a

### TRIANGLE.

This triangle must vary in size according to the part to be covered by it; though the largest of those employed at Lausane is about a yard in length, and a half yard from its summit to the centre of its base. When it is wished to have a smaller triangle, divide this according to the line *c d*, or cut off portions on each side, Fig. 93. Thus formed, the parts of the triangle are the base *a b;* the angles or extremities are the points of these same letters; and the summit is *c.* In order to apply



Fig. 93.
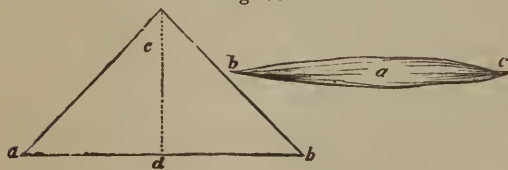
it, hold the handkerchief smoothly by the base, placing the thumbs above or on the upper surface, and the fingers widely extended on its under surface; then apply the base first, and carry the extremities around the part so as to cover in the summit, making folds or plaits in any portion that may project.

The **Oblong Square**, shown in Fig. 92, does not require explanation, as it is readily seen to be formed of the common square doubled once on tself.

The **Cravat**, Fig. 93, is so well known as also to require no explanation, the shape being that which is daily employed in arranging the covering to our necks. Like the triangle, the body or base (*a*) of the cravat is the part first applied, and this is retained in its position by attaching the ends (*b c*) to the other parts of its body.

The **Cord** is made by twisting a cravat on itself. It is of great utility in compressing vessels, especially in the Garotte or Spanish windlass, which on an emergency will be found to be a good substitute (see HEMORRHAGE) for the ordinary tourniquet.

## SECTION I.

### OF THE HANDKERCHIEF AS APPLIED TO THE HEAD.

The first application of the Handkerchief is to cover in the whole head, and is called

### 1. *The Square Cap of the Head.*

Form the handkerchief into an oblong square, and let the edge of the side to go next the head be three inches longer than the other. Draw the ends of the short side (1 1) down the sides of the face, and tie them under the chin; then draw the inner ends, or those of the long side, (2 2,) forward,
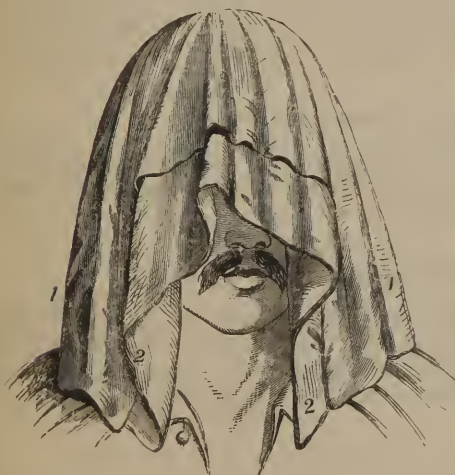
Fig. 94.    Fig. 95.



gathering them up, to free them from the former, and turning them backward, tie their ends on the nape of the neck, as in Fig. 95.

*Use.*—To cover in the head, ears, and jaw.

### 2. *In the Fronto-Occipital Triangle*

The base is placed before the forehead, higher or lower, according to circumstances, while the lateral angles or tails are crossed at the occiput, and

then brought forward as far as the temporal regions, or on to the forehead, where they are fixed by means of pins, Fig. 96.

The summit is then turned over and fastened at the vertex, by being made to pass under the angles, whence it is reflected upward and pinned, as in Fig. 97.

Fig. 96.



Fig. 97.
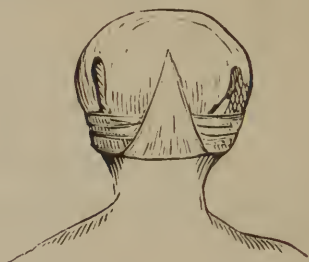


*Use.*—To retain dressings to the head.

### 3. *For the Occipito-Frontal Triangle*

Place the base at the occiput; cross the tails upon the forehead, and pass the summit underneath the frontal portion so as to reflect it upward.

*Use.*—Same as the former, but better when pressure may be required on the forehead, as by crossing the angles or by knotting them considerable force may be employed.

### 4. *In the Bi-Temporal Triangle*

The base is placed upon one of the temples, and the summit turned over toward the opposite ear and confined by the angles carried around the head.

*Use.*—To retain dressings to the head.

### 5. *The Simple Oculo-Occipital Triangle*

Requires that the base should be stretched obliquely from the superior part of the temporal region of the sound side, over one eye, to the sub-mastoid region of the diseased side; the summit being carried diagonally backward to the posterior portion, where it crosses at the side of the neck corresponding with the sound eye.

*Use.*—To cover in one eye.

### 6. *In the Fronto-Occipito-Labialis Cravat*

Place the body against the forehead; cross the tails on the nape of the neck, and bring them forward to either lip, where one is to be passed through a slit perforated near the extremity of the other. These extremities being then pulled in contrary directions, over the compresses on each side of the wound, and secured by a couple of small pins or a few stitches under the ears, complete the bandage. If a triangular handkerchief is used, the summit should be carried to the vertex, passed under the first intercrossing, reflected upward, and pinned, as in Fig. 98.

*Use.*—To sustain the union of wounds of the lip, or after the hare-lip operation ; or to confine dressings, or unite wounds in the absence of other means.

Fig. 98.



Fig. 99.



### 7. *In the Facial Triangle, or Mask,*

Place the base of the handkerchief in triangle, under the chin, the summit on the forehead, and carry the angles over the ears to the vertex, where they may be crossed and brought on the forehead, in order to confine the summit. Holes or slits are then to be made for the eyes, nose, and mouth, Fig. 99.

*Use.*—To retain dressings to the face.

### 8. *In the Vertico-Mental Triangle*

The body of a broad handkerchief is placed on the vertex, and the ends carried under the chin and fastened to the sides of the first turn, near the ears. The summit is then to be pinned on the side of the head, as in Fig. 100.

Fig. 100.



*Use.*—To retain dressings under the chin, or to the base of the jaw, or on the parotid region.

### 9. *The Auriculo-Occipital Triangle*

Fig. 101



Is made by the base being placed obliquely in front of the injured ear, while the summit is carried round toward the same ear. One angle then going under the jaw of the side affected comes up in front of the opposite ear, where it makes a knot which ties under the ear, or turns around the other angle, so that the two may run round the occiput, one in front, the other behind, to tie on its side or on the jaw.

*Use.*—To retain dressings to one ear, or to the angle of the jaw, without interfering with the opposite ear, Fig. 101.

### 10. *The Occipito-Sternal Handkerchief*

Requires two handkerchiefs, one in cravat, the other in triangle. Place the base of the triangle on the occiput, with the summit anteriorly, and bring the tails down along the sides of the head and face, so as to fasten them to the front of a *sterno-dorsal* or *dorso-thoracic cravat*. To render this handkerchief more secure, a nightcap may be placed on the head, as in

Fig. 102.



Fig. 102. Care must also be taken to flex the neck thoroughly, so as to prevent the loosening of the bandage by the subsequent motions of the patient, especially if insane or suffering from mania a potu.

*Use.*—To unite wounds of the throat, and bring the head to the chest in any case where there is danger from extension of the neck. In patients bent

on suicide, this bandage aids the union of the wound by insuring rest and preventing the tearing out of the stitches. It is important that the thoracic handkerchief should be of firm material and maintained in its position by a perineal band. If the patient is violent the hands should also be confined.

## 11. *The Fronto-Dorsal Handkerchief*

Is the reverse of the above. The base of the triangle is upon the forehead, the summit carried posteriorly, and the tails turned downward and backward, to be fastened to the back of a *dorso-thoracic cravat*.

*Use.*—Reverse of the former, or to unite wounds of the back, of the neck, etc. A cap on the head, as shown in the previous bandage, is also necessary here.

## 12. *In the Parieto-Axillaris Handkerchief*

Place the base of a triangular handkerchief on one side of the head, with the summit carried to the opposite side, and tie the ends to an axillo-acromial cravat, as in Fig. 103.

Fig. 103.



*Use.*—To bring the head to one side, as in wry-neck, spasm of the sterno-cleido muscle, or in burns of the opposite side, where there is danger of contraction. In incised wounds of the side of the neck, this bandage will sometimes prove a valuable adjuvant to sutures, particularly if the wound is sufficiently transverse and deep enough to involve the muscles of this region. Its utility, in all cases, will depend in a great measure on the skill with which the axillary handkerchief is applied. In some cases it will be necessary to pad or otherwise protect the margin of the axilla. This handkerchief is also occasionally useful after plastic operations, for the relief of the deformity caused by cicatrices from burns.

## SECTION II.

### OF THE HANDKERCHIEF AS APPLIED TO THE TRUNK.

The first of these is very simple, and constitutes

### 1. *The Cervical Cravat of daily Use.*

It has the centre before the larynx, side of the neck, or cervical vertebræ, according to circumstances—constituting an *anterior, lateral,* or *posterior cervical cravat.*

*Use.*—As a retaining bandage for dressings applied to the neck this handkerchief is much employed, the peculiar shape of this region, especially at its connection with the chest, being such as to require a bandage to be cut with a slope, like an ordinary neck-tie or stock, in order to fit it, unless we resort invariably to the simple handkerchief just described. As the neck will not tolerate compression without a risk of interruption of the course of the blood in the head, this handkerchief generally proves the best method of retaining dressings to this part of the body.

### 2. *In the Simple Bis-Axillary Cravat*

Place the body of the cravat in the axilla of the affected side ; cross the ends over the corresponding shoulder, and then carry them, one before, the

Fig. 104.
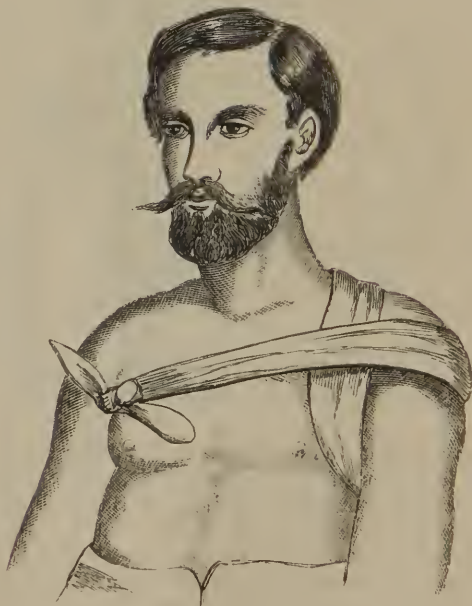


other round and behind the chest, to the axilla of the opposite side, where they are to be secured, Fig. 104.

*Use.*—To retain dressings to the axilla, as poultices in the treatment of abscesses; or in caries of the head of the humerus, or to retain a dressing to the point of the shoulder. In wounds of the margin of the axilla, or in hemorrhage from the axillary vessels, this handkerchief will also often prove useful. As a means of retaining dressings requiring frequent changing, it is an excellent substitute for the spica bandage of the shoulder. In tying the ends be careful to protect the opposite axilla, by placing a compress there.

### 3. *In the Compound Bis-Axillary Cravat*

Place the centre of a cravat on the axilla of the sound side; carry the tails obliquely upward to the base of the neck at the opposite side, and fasten their extremities; next apply the centre of a second and smaller cravat in the axilla of the affected side, and attach its tails to the corresponding portion of the first, Fig. 105.

Fig. 105.



*Use.*—The same as the former handkerchief, but to both axillæ. The advantage possessed by this handkerchief over the preceding one is found in the fact that the two handkerchiefs, in cravats, may be so arranged as to cause their bodies or the broad portion to cover in particular points of this region. Thus, in the event of a wound of the axilla, a firm compress being first arranged, the circular cravat of the shoulder, seen on the right side of Fig. 105, can readily be made to draw upon it, so as to exercise a firm and equable compression. By reference to the figure, this pressure, it will be seen, is made to act directly upward. The opposite cravat, as thus arranged, is also likely to compress the anterior and inferior border of the left axilla, at a point where pressure might be required in the event of a wound involving the pectoral muscle and opening some of the branches of the external mammary arteries. This

handkerchief may also be resorted to in fractures of the coracoid process of the scapula as an adjuvant to other dressings, as well as after amputations of the shoulder-joint, to retain dressings to the stump.

### 4. *In the Simple Bis-Axillo-Scapulary Cravat, or Posterior 8 of the Shoulder,*

Place the centre of the handkerchief between the scapulæ, carry one of the tails over the corresponding shoulder and under the axilla. Fasten the extremity by strong stitches to the body of the cravat, and conduct the other tail under the corresponding axilla and over the shoulder toward the extremity of the first, upon which it should be similarly secured, as in Fig. 106.

Fig. 106.



*Use.*—The same as the preceding. This handkerchief is an excellent substitute for the posterior 8 of the chest, as shown in Fig. 51, p. 117, especially in cases requiring a frequent change of dressings. As thus applied, the body of the handkerchief comes upon the edges of the axilla, but does not make pressure, like the posterior 8, when formed by the roller, consequently it is much more comfortable. This handkerchief will also be found useful in retaining dressings to burns of the pectoral region, and especially in preventing the contraction of cicatrices, or the adhesion of the arm to the side of the axilla. In fractures of the clavicle, accompanied by wounds or other injuries, confining the patient to bed, it will often suffice for the treatment of the early stages before a firmer dressing can be borne, and when the ends are fastened by pins, as in Fig. 106, they will lay so smoothly as not to incommode the patient, if compelled to lie upon his back in bed. In cases of luxation of the sternal end of the clavicle backward, it will tend to prevent a renewal of the dislocation after its reduction, giving a firm and equable support while carrying the shoulders well backward.

### 5. *In the Compound Bis-Axillo-Scapulary Cravat*

Knot together the two extremities of a cravat about one of the shoulders, so as to make of it a loose ring; next take a second cravat, apply the centre of this against the anterior face of the other shoulder, and, conducting the tails, one over the shoulder and the other beneath the axilla, let the first embrace the corresponding portion of the ring, in order that its extremity may be united with that of the second tail, which should be made previously to pass about the first in the manner represented in Fig. 107.

Fig. 107.
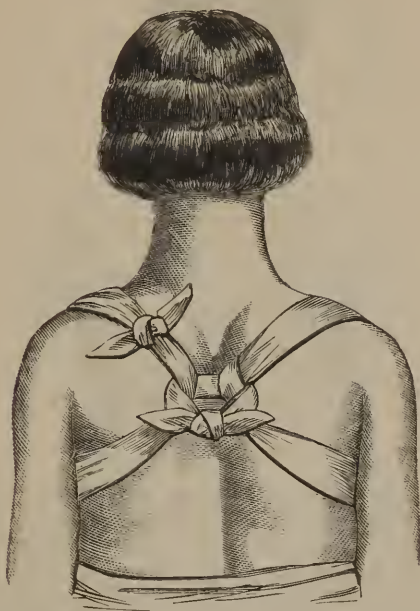


*Use.*—The same as the two preceding, but preferable to either on account of the much greater power it may be made to exert. Though more powerful, this handkerchief is not so often resorted to as the preceding one, because it is liable to make too much pressure on the margins of the axillæ. The knots formed on the back are also often objectionable; yet in wounds, where other means of arresting hemorrhage are not accessible; in fractures of the clavicle, as an addition to Mayor's bandage, as hereafter described in connection with this injury; in luxations of the sternal end of the clavicle; in luxation of the latissimus dorsi from the inferior angle of the scapula, and similar injuries, in which it is desirable to carry the shoulders forcibly backward, it may be advantageously resorted to. In tying this and other handkerchiefs, square knots, like those employed in the neck-tie, should be made, as they cause less pressure, and are not so inconvenient when liable to be pressed against the body. In most cases simple padded bands or rings, united on the back by a piece of tape, will answer equally as well for the objects of this handkerchief, and be much more comfortable to the patient.

### 6. *For the Dorso-Bis-Axillaris*

Place one handkerchief, in cravat, around the chest, under each axilla, and the other in triangle on the back, with its base upward. Fix the summit of the triangle to the circular cravat, and, carrying the angles over each shoulder, fasten them to the circular handkerchief in front and on the sides of the chest, in the manner shown in Fig. 108.

Fig. 108.

*Use.*—To retain dressings to the upper part of the back, the top of the shoulder, and over the bodies of the scapulæ, especially when the articles applied—as poultices—require frequent changing during the day. If the summit of the triangular handkerchief is fastened to the circular cravat in front, and the angles brought over each shoulder to be pinned behind, it will retain dressings to the front of the chest, and form a *Cervico-Thoracic Handkerchief*. When the clothes of children or females take fire, the rise of the flames not unfrequently causes the shoulders to be badly burned. In such cases, in carbuncle, in caries of the scapula, gunshot wounds, or the extirpation of tumors from this region, no better means of retaining dressings can be suggested than this handkerchief, as it is soft, light, and easily removed, without materially deranging the patient's position. When under any of these circumstances a change of dressing is demanded, it is only requisite to take out the pin which fastens the summit of the triangular handkerchief (Fig. 108) to the circular cravat surrounding the thorax, and, turning up the point, expose at once the whole region. On renewing the dressing, bring the summit again to its position, and fasten it as before. When used to retain dressings to the front of the chest, loosen the anterior angles, and allow the summit to remain. The natural application of this handkerchief as a means of covering in this region of the body is apparent, from its frequent use by females as an article of dress. In the treatment of carbuncles in this region it will especially commend itself, from the perfection of its adaptation to the shape of the part and the facility with which it can be removed without causing the patient any inconvenience.

### 7. *In the Triangular Cap of the Breast*

Place the base of a handkerchief, folded as a triangle, A, obliquely across the chest and under one breast, with the summit C over the corresponding shoulder, and, carrying one angle B over the opposite shoulder, and the other B under the corresponding axilla, tie them on the back of the shoulder. Then confine the summit by a pin or tape to the angles.

Fig. 109.



*Use.*—To retain a dressing to, or support the breast during lactation, or after the operation of amputation of the mammary gland. The advantage of this bandage is the simplicity of its application, the perfection of its support, and the perfect control of it maintained by the patient. In cases of mammary abscess, ulcerated nipples, encephaloid disease of the breast, pendulous mamma, etc. it will be found highly useful. When it is desired to uncover the breast, the patient need only place her hand over the shoulder of the affected side, undo the summit, and, turning it down, fully expose the bosom, while at the same time the gland will be supported by the oblique turns, A B, Fig. 109. Then arrange the dressing, or in cases of pendulous breasts after suckling the child, reapply and fasten the summit as before. In numerous instances patients have expressed their satisfaction at the comfort afforded by this handkerchief, as well as gratification at the facility with which they could arrange it for themselves, an important point in those engaged in suckling and suffering from the dragging of a heavy breast.

### 8. *The Inter-Femoral Handkerchief*

Requires the base to be applied on the back of the body; the angles brought round the pelvis; and the summit to be carried over the perineum, to fasten to the angles in front, as in the diapers of children.

### 9. *In the Sub-Femoral Handkerchief*

One handkerchief, in cravat, goes circularly around the pelvis. The base of another, which is in triangle, is applied obliquely on the thigh, the angles passing circularly around its upper part, and the summit obliquely up between the nates, to be fixed to the circular band, as shown in Fig. 110.

Fig. 110.
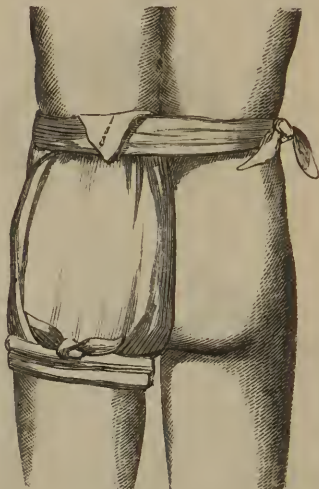


*Use.*—As a means of covering the posterior portion of the body, and the only one that does cover the buttock with neatness and accuracy.
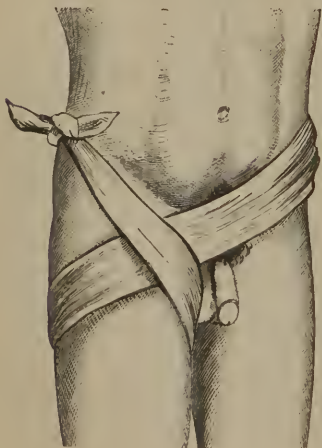
Fig. 111.　　　　　　　　　　　　Fig. 112.



### 10. *In the Single Spica*

Place the body of a cravat in the line of the groin, and carry one extremity around the pelvis, the other around and below the thigh, to meet it on the

groin, as in Fig. 111. If not long enough to tie, attach tapes to the extremities of the handkerchief.

*Use.*—To retain a dressing to one groin. When it is desired to cover in the hip, the handkerchief may be spread out and applied as in Fig. 112, which thus forms a most excellent mode of retaining a dressing to this region, and is especially useful in the abscesses attendant on coxalgia. The single spica handkerchief is the best mode of retaining a poultice to a bubo, in consequence of the ease with which it may be removed without disturbing the patient.

### 11. *For the Double Spica*

Fold two handkerchiefs, in cravats, and tie an extremity of each together. Place the knot a little on one side of the spine, and carry the free extremity of each round over either innominatum, in the line of the groin, between the thighs, and round their outside, to come up and fasten to the bodies of the cravats, as shown in Fig. 113.

*Use.*—To retain dressings to both groins.

Fig. 113.
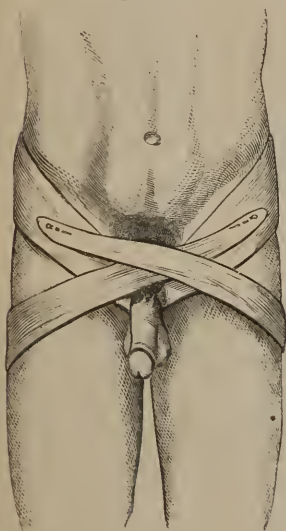
Fig. 114.
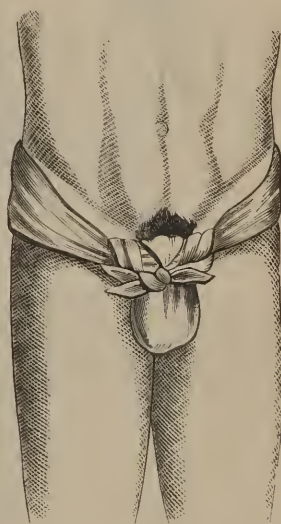


### 12. *To make the Suspensory, or Scroto-Lumbar Triangle,*

Form a lumbo-abdominal cravat for a belt, and apply the base of a triangle to the under and back part of the scrotum. Carry the tails to the fore part of the belt; pass them about this, from before backward, as represented in Fig. 114, and tie the extremities, so as to bring the knot in front and prevent its chafing. Next carry the summit upward, pass it under the transverse portions of the tails and under the belt, reflecting it over the fore part of the handkerchiefs, so as to secure it with a pin.

*Use.*—To support the testicles, large scrotal hernia, or to retain the water-dressing to cancer of the testis, epididymitis, etc.

## SECTION III.

### OF THE HANDKERCHIEF OF THE UPPER EXTREMITIES.

The Handkerchiefs of the Upper Extremities are an excellent class of bandages, and may frequently supplant the ordinary roller with advantage.

### 1. *The Cervico-Brachial Sling*

Is made by placing one handkerchief, in cravat, around the neck, and

Fig. 115.



knotting its ends over the sternum. Place the other in a triangle under the forearm, so that its base may be next the wrist; then tie its angles to the cravat, and carry the summit around the elbow to fasten it to the body of the triangle in front, as in Fig. 115.
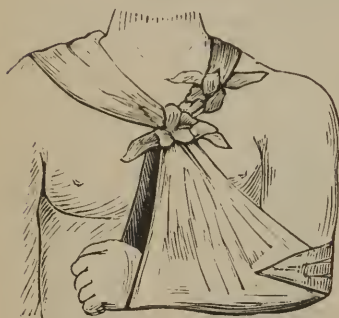
*Use.*—To support the forearm. This method of forming a sling is better than the common plan, as the knots do not cut the back of the neck, owing to the position of the body of the cravat; while the summit of the triangle, being fixed at the elbow, keeps the arm more closely to the side of the body.

### 2. *The Ante-Brachial Trough*

May be constructed either of leather or pasteboard, which latter may be covered by some appropriate material, with the view of preserving its form, or even giving it a sort of embellishment. It may be either straight, that is to say, open at the level of the elbow, or, as represented in Fig. 116, term-

Fig. 116.



inating there in a cul-de-sac. A long ribbon or cord is required to serve for its suspension, and constitutes two collateral bows, to which the author applies the term *arc-loops;* lastly, a cravat, so arranged as to constitute a Cervical Cravat. Four holes being previously bored through the trough at convenient distances apart, near its borders, the cord is run through them, in order to form the loops, which in their passage should be made either to glide through the Cervical Cravat, as represented in the cut, or, what is better, through a ring, which serves to connect them, and allows of a free play of the loops, a point from which the patient will derive no small convenience. When the apparatus this us pre-

pared, nothing remains to be done but to introduce therein the patient's forearm, which has been, if fractured, previously furnished with its dressing.
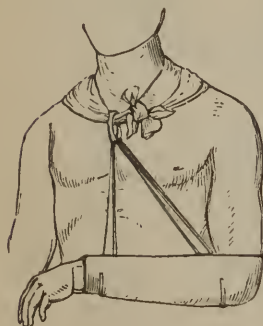
*Use.*—This apparatus may be worn inclosed in the patient's ordinary dress, so as not to give the appearance of the arm being subjected to con-

finement. But if it be required to preserve the elbow fixed against the trunk, a ribbon must be made to pass through a couple of holes perforated in the internal portion of the trough, or that which corresponds to the body, and embrace the trunk, as a belt or body-bandage. If it be necessary to give support to the hand or wrist, a thin, flat piece of wood may be laid at the bottom of the trough, and its projection beyond the end of the latter regulated by circumstances.

### 3. *In the Triangular Cap of the Shoulder*

Place the base of the triangle at the insertion of the deltoid muscle or elbow; carry the summit over the acromion, and the angles round the arm, tying them on it, as in Fig. 117.

*Use.*—To retain dressings to the round portion of the shoulder or middle of the arm, which it does very perfectly.

Fig. 117.

Fig. 118.
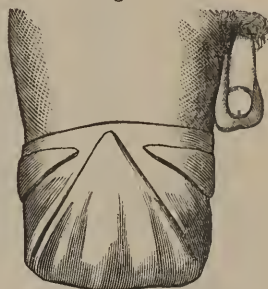


### 4. *In the Triangular Cap of Amputations*

The base of a handkerchief or piece of muslin of a triangular shape is to be placed under the limb, at a convenient distance from the extremity of the stump, the angles of which are to be brought forward and overlapped, and the summit carried over the stump and fastened to the circular portion or the body of the handkerchief. In this last part of the process take care that the handkerchief or linen embraces, very accurately, the extremity of the stump, as shown at Fig. 118.

Or, instead of commencing with the lateral angles, the summit may be first carried upward in the manner described, and then the tails, in encircling the limb, be made to include its extremity.

*Use.*—Whether employed in amputations of the upper or lower limbs, of the fingers or toes, or even of the penis, nothing can be more simple or more effectual than this bandage. In general, no further precaution is necessary than to insist upon the patient remaining quiet; for, if the handkerchief be carefully applied, there will be hardly a possibility of any derangement. But should it be absolutely necessary to have recourse to some expedient to prevent it from becoming detached, a cravat belt may be applied about the neck or pelvis, the lower part of the arm or thigh, the wrist or ankle, according to the seat of operation, and the handkerchief fastened to it by bands or tapes.

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### 5. *In the Carpo-olecranien*

Fold three handkerchiefs into cravats, and apply one circularly around the arm above the elbow and one around the hand; then tie one extremity of the other to that which is around the articulation of the carpal and metacarpal bones, so that the knot may come on the palm of the hand, and attach the other end to the circular cravat, as in Fig. 119.

Fig. 119.



*Use.*—To keep the hand and forearm extended, in the posterior luxations of the wrist or elbow, or in the latter stages of fracture of the olecranon, as a temporary dressing.

### 6. *In the Flexor of the Wrist*

Place a cravat circularly round the arm above the elbow, and a triangle around the hand, so that the summit may be folded over, and fastened by one angle around the wrist; flex the hand and forearm, and attach the other angle to the cravat on the front of the arm, as in Fig. 120.

Fig. 120.



### 7. *For the Carpo-dorsal, or Palmar Triangle,*

Place the base of a triangle on the dorsal or palmar surface of the wrist, and carry the angles round this and the summit over the fingers, which should be thus fastened, if a dorsal handkerchief is wished; if not, slit holes in the handkerchief, as in the perforated T of the hands, and, passing the fingers through them, attach the summits to the angles.

Fig. 121.



*Use.*—To retain dressings to the back or front of the hand, or between the fingers, and keep the hand flexed.

## SECTION IV.

### OF THE HANDKERCHIEFS OF THE LOWER EXTREMITIES.

These handkerchiefs supply a covering for parts that often embarrass the practitioner to retain dressings on, by any other means.   The first is:—

### 1. *The Metatarso-malleolar Cravat.*

Place the body of the cravat obliquely across the instep, and carry one extremity round above the malleoli, the other round the sole of the foot and instep, to join it on the front of the ankle, as in Fig. 122, and also in the lower part of Fig. 128.

*Use.*—To retain dressings to this part, as after tying the anterior tibial artery; but where pressure is required, the spica of the instep should be substituted.

Fig 122.



### 2. *To make the Triangular Cap of the Heel*

Apply the base of a triangle to the sole of the foot, directly under the instep; carry the summit over one malleolus; cross the angles on the instep, and then carry them around the malleoli to confine the summit, as in the foot of Fig. 123, at A.

*Use.*—To retain dressings to the heel.   This is an excellent bandage in the treatment of the excoriations sometimes consequent on the use of an extending band in the treatment of fractures of the thigh.

Fig. 123.



### 3. *The Tarso-pelvien Cravat*

Requires one circular cravat around the pelvis, and the body of a second on the top of the foot, with one end tied under the sole and the other fastened to the pelvic band, as at B, Fig. 123.

*Use.*—To support the limb or to keep the foot extended, as in ruptured tendo-Achillis.

### 4. *The Compound Metatarso-rotular Cravat*

Is composed of four cravats—a hollow pasteboard or split deal splint, and some soft compresses; then, the patient's limb being placed in the most complete extension, and the heel kept elevated above the level of the tuber ischii by means of a pillow, the centre of the first cravat is to be applied

against the anterior part of the thigh, immediately above the patella, and its extremities carried backward, crossed, and returned to the anterior part of the leg immediately below that bone; by drawing on these, the two broken surfaces will be placed in tolerable apposition.   The centre of the second cravat should then be applied against the sole of the foot, one extremity loosely knotted upon the metatarsus, and the other subsequently carried upward on one side of the knee to the supra-rotular portion of the first cravat, to which it is to be attached, as seen in Fig. 124.   The sole of the

Fig. 124.



foot here serves for a point of support; and this second cravat, aided by the respective positions of the leg, of the thigh, and of the pelvis, tends to counterbalance the action of the extensors of the leg.   But to obviate still more any possibility of flexion of the latter upon the thigh, which these cravats would not in all instances be enabled of themselves to counteract, recourse is had to a hollow splint, which is well lined with soft compresses, and applied against the posterior surface of the limb.   This is fastened in the simplest manner by the two remaining cravats.

*Use.*—As a temporary dressing in fractured patella, incised wounds of the knee, etc.

Fig. 125.



### 5. *The Tarso-Patella Cravat*

Requires one handkerchief, in cravat, around the knee in a figure of 8, so as to embrace the patella; the middle of another being under the instep, and one end of a third cravat tied on its outside, the other passed on each side under the cravat at the knee, as in Fig. 125.

*Use.*—In fracture of the patella.

### 6. *In the Malleolar Phalangial Triangle, or Cap of the Foot,*

Place the base of a triangle under the instep; carry the summit over the toes, and the angles around the malleoli, to inclose the foot, as shown in Fig. 126.

*Use.* —To retain dressings to the foot.

Fig. 126.

### 7. *In the Tibio-Cervical Cravat, or Sling,*

Apply the body of a cravat to the shoulder opposite to the side affected, and bring down the tails obliquely to just above the crest of the ilium of the side corresponding to the injury, so as to give it, when knotted, the appearance of a band.   Then, flexing the leg to a right angle, apply a handkerchief in triangle on its anterior face, the base corresponding to the ankle, and the summit to the knee ; next, carrying the tails, one along the inside and the other along the outside of the thigh, attach their extremities securely to the cervical cravat near the pelvis, as seen in Fig. 127.

*Use.*—To support the limb after the treatment of fractures of the leg, or in sprains of the ankle, where the patient is desirous of walking about with a crutch.

Fig. 127.                                          Fig. 128
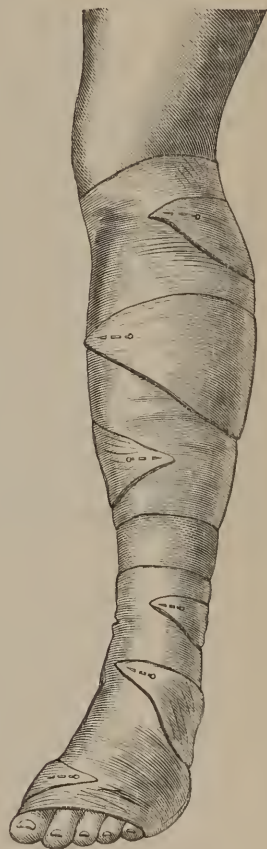


### 8. *In the Tibial Cravat*

Place the body of a broad cravat obliquely across the back of the leg, and carry one extremity round the leg below the knee, the other above the ankle, to meet and tie or pin on the front of the calf or spine of the tibia, as in the

upper portion of Fig. 128.   The foot of this cut exhibits the application of the metatarso-malleolar cravat.

*Use.*—To confine Sinapisms, Blisters, etc. to the calf.   The figure of 8 turns of this handkerchief prevent its becoming deranged by the movements of the patient.

### *Barton's Handkerchief.*

A very excellent method of making an extending band for the treatment of fracture of the thigh has been proposed by Dr. J. Rhea Barton, of Phila-delphia.   Dr. Barton was led to this application of the handkerchief by seeing how well the pressure of the boot on the heel and instep was borne, and how frequently excoriation and troublesome ulceration of the heel fol-

Fig. 129.



lowed the use of the ordinary band or gaiter which pressed directly on the sharp edge of the tendo-Achil-lis.   With these views, he folded a handkerchief into a narrow cravat, and placed the body of it directly on the extremity of the os calcis, below the tendo-Achillis, so that two-thirds of the cravat came round under the outer malleolus, and the other third remained on the in-side.   The inside portion remaining parallel with the sole of the foot, the outside piece was carried over the instep and passed round it so as to form a sort of knot. Then, passing under the sole of the foot, it is turned around the first turn, and forms another knot at the metatarsal articulation, when both ends are carried off perpendicularly from the sole of the foot and fastened to the splint—the pressure coming directly on the in-step and point of the heel, as seen in Fig. 129.

When ulceration on the front of the ankle-joint or on the heel has been produced by the use of the gaiter or extending band formerly resorted to in the treatment of fractures of the thigh as a means of making extension, this handkerchief will be found to avoid the sore points and yet keep up a permanent extension.   The employment of adhe-sive plaster for the purpose of making extension has, however, diminished materially the number of cases in which the utility of this handkerchief could be tested.

# CHAPTER V.

Under the head of Elementary Operations are to be studied such duties of a primary character as are essential to the complete success of all surgical operations of a grave nature. These may be classified as those required for the preparation of the patient, of the instruments, and of the assistants, as well as the after-treatment of the parts operated on, as the arrest of hemorrhage, union of the wound, etc.

## SECTION I.

### PREPARATION OF THE PATIENT.

As every operation in surgery is undertaken solely with the view of benefiting the patient, the duties of an operator commence with the establishment of a correct diagnosis. Certainty, or a cautious examination of the nature of the disorder, should in all instances be a *sine qua non* to any operation. Without it every application of the knife becomes barbarous and unjustifiable; and he who entertains a just view of the responsibilities of a surgeon will ponder seriously upon the propriety of operating in any case where he is likely to expose his patient to greater risks than those arising from the treatment of the affection by other remedial measures.

The Prognosis of an operation, or the opinion that the result to the patient will be preferable to his condition before it, should in like manner be firmly settled; but as all men are liable to error, even when caution is largely exercised, it becomes the surgeon's duty to demand a consultation with one or more of his professional brethren in every case where it is possible, not only in order to render the necessity of the operation certain, but also to secure his own reputation as to its correctness. The many cases of error of judgment that have been published, through the honorable candor of surgeons possessed of the highest skill, renders such a course essential not only to the comfort of every young operator, but also absolutely necessary to his personal safety, and immunity from the vexatious legal actions so often exhibited at the present time in many portions of the United States. The propriety of amputations has more than once been subsequently doubted; lithotomy has been performed when a calculus did not exist; while the cure of fistula in ano, or the performance of plastic operations, has sometimes left the patient in a worse condition than he was previously. The result, also, is by no means the same even under apparently similar circumstances. Death has occasionally ensued from an apparently simple operation; a greater

deformity has been created by operating for strabismus than that which pre-
viously existed, and new noses have not always proved as handsome as the
old.   The issue should, therefore, be carefully weighed by each surgeon
before operating, if only on account of his own reputation.   But when, after
due deliberation, the affair has been decided, let him immediately, and with
perfect confidence, assume his part as the operator, and give his attention
to such general and local measures as will facilitate the accomplishment of
his object.

### § 1.—Duties of a Surgeon before Operating.

Among the first of the general measures required before operating may
be placed the employment of such means as are occasionally necessary to
induce the patient to consent to the performance of the operation.   Some-
times it happens that the individual is so timid and fearful of pain as to
require strong inducements to lead him to suffer that which is requisite for his
cure.   Under such circumstances, the surgeon may be obliged to promise
largely, or present a lively delineation of the benefits that will result from
its performance ; but if, on the other hand, his patient is over-bold, or has
obtained too exalted an idea of the advantages that will accrue from the
operation, it may become necessary to diminish his anxiety to submit, by
pointing out the risks to which he will be exposed, lest, anticipating too
much and being disappointed, he throw the blame upon his surgical
attendant.

Especially is this caution requisite in the case of females who demand an
operation for the improvement of their appearance.

A young girl is annoyed by a squint, and hopes to augment her beauty,
or she has been disfigured by a burn, or deformed from a fracture, and, full
of the successful histories of friends and neighbors, almost insists upon an
operation.   In these cases it is imperatively the surgeon's duty to display
the darker tints of the picture, and limit the anticipations that hope and
vanity have so readily created.

In this, which has been termed the "moral preparation" of a patient,
many of the measures necessary to be employed must be decided by that
indefinite quality of the mind known as "tact," or that nice perception
which enables any one to anticipate the most agreeable method of accom-
plishing an object.   Some surgeons possess it naturally in a high degree,
while others are less brilliant.   A proper study of character, together with
a close observation of the mental weakness of those who exhibit such pecu-
liarities, will, however, do much toward aiding any surgeon to obtain such
an amount of it as will enable him to control, if he cannot change, his pa-
tient's peculiarities.   Nor is this study of a patient's mental idiosyncrasies
only of importance in respect to his comfort; it is also often found to be
closely allied to the result of the case.   Fear depresses the vital powers, but
hope enlivens and elevates them ; and their undue excitement in any case
may, therefore, either prove a serious obstacle or a powerful lever to the
attainment of the surgeon's object.*

From the extensive sympathies of one organ with another, it also becomes
the operator's duty, at this stage of his proceedings, to look not only at the
mental, but also to the physical condition of his patient.   Let him see that
the digestive organs are as far as possible free from disease, and active in the

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* For many excellent details on the moral preparation of the patient, see Pathologie
Externe, par Vidal du Cassis, tome i.; also Velpeau's Surgery, by Drs. Mott and Town-
send, vol. i., New York, 1847.

performance of their functions; that the secretions of the liver and kidneys are not obstructed; that the lungs and heart are in a proper condition for the circulation of the blood, and that the head is free both from mental and physical disorders; in other words, let him always satisfy himself, before operating, that his patient is possessed of the *mens sana in corpore sano;* or that he is, as far as may be, sound both in body and mind.

After thus attending to the general preparation of the patient, the surgeon should next turn his attention to the use of Anæsthetics, especially before severe operations. As the safety of such a course has been most widely tested at the present day, philanthropy, and that desire to ameliorate the sufferings of mankind, which is the true basis of sound practice, demand that neither prejudice nor ignorance of their effects should prevent their employment by every operator.

Since the use of Ether as an anæsthetic was suggested, either by Morton, of Massachusetts, or Wells, of Connecticut,—opinion differing on this point,— it has been widely brought to the notice of the profession by Dr. John C. Warren, and to him alone are we indebted for our first ideas in reference to its proper administration in surgery.

From an early period after Warren's suggestion of its utility in surgery, pure ether was administered by me; but for several years I have more frequently resorted to a mixture of ether and chloroform, in the proportion of one part of the latter to five of the ether by weight, and have yet to see the first patient in whom evil has been caused by its use. Pure chloroform, though highly esteemed by many surgeons, and especially by those of Europe —the experience of the Crimean war in its successful administration alone amounting to 30,000—is yet deemed by others a more dangerous anæsthetic, reports of the deaths ensuing upon its administration being yet frequently noted.

Ether, or ether and chloroform mixed in the proportion just stated, may be safely administered by any well-educated physician. That it is a powerful sedative, and liable to abuse, cannot be doubted; yet is it by no means so dangerous as aconite, morphia, or many other articles of the materia medica in daily use. That any anæsthetic requires to be judiciously or even cautiously administered, is also true; but there is no portion of our professional duties which does not require the same caution; and the liability of anæsthetics to be abused is therefore no argument against their proper use.

In the administration of anæsthetics, almost any article will answer for the application of the vapor to the mouth of the patient, such as a hollow sponge, towel, or handkerchief. But as anæsthetics are exceedingly volatile, much will be wasted when they are thus employed; in addition to which, the operator is apt to suffer from the lassitude consequent on breathing the atmosphere around the patient while administering ether in this manner during a prolonged etherization. The use of a simple cone of paper, freely open at both ends, yet surrounding the sponge, is preferable, as it prevents the waste of ether, and yet furnishes quite enough air to obviate any inconvenience to the patient.

The importance of recognizing the precise period when anæsthesia is induced, and thus guarding against the administration of an unnecessary amount of the anæsthetic agent, has induced surgeons to pay special attention to the signs which most correctly indicate when the patient has had enough, at least for the moment, and I shall briefly state them in connection with the mode of administration pursued by myself in many hundred cases, without ever having seen any ground for the apprehension of danger.

**Administration of Anæsthetics.**—The purest ether and chloroform being ready mixed, in the proportion of one part of chloroform to five of ether by

weight, and well shaken together in a bottle, a good soft, porous, cup-shaped
sponge, which has been previously soaked in warm water and then wrung nearly
dry in a towel, should be moistened by pouring over its surface about half an
ounce of the mixture.  The patient being then placed in the proper position
for the operation, should have the neck entirely freed from the constriction
of any portion of the dress, the precaution having been also taken to keep
the stomach empty for three hours before the operation.      The assistant
who is to administer the anæsthetic—and he should do nothing else—having
then placed himself near the patient's head, should hold the sponge or cone
lightly between his thumb and forefinger, so that his hand may not obstruct
the passage of fresh air through the cells of the sponge, and apply it within
two inches of the patient's mouth and nostrils.    Then, while feeling the
pulse with the other hand, let him direct the patient to take a long inspira-
tion, and also to expire through the sponge.  As the patient's lungs become
accustomed to the stimulus of the vapor, the assistant should at once apply
the sponge closer to the mouth and nostrils, turning it round occasionally,
and taking care not to compress it, lest the ether escape from the sponge
upon the patient's skin and irritate it.    When the cone is employed, this in-
convenience is obviated.    After a few inspirations, or in about two or three
minutes from the commencement of the inhalation, the pulse will be found
to quicken till it may count 100 or 120, and then, as the respiration becomes
slower, to gradually diminish in frequency.  At this period—that is, when the
pulse commences to change its frequency—close attention should be paid to
the perfection of the inspiration, and a careful examination made of the state
of the patient's muscles.    If these continue to act, anæsthesia is not yet
perfectly induced ; but if, while the patient is quiet, his arm, on being raised,
drops as if lifeless, or if the eyelid, when opened, remains so, or simply
drops, and the eyeball continues turned upward, the pulse remaining of good
volume, anæsthesia is perfect, and the operation may safely proceed, the
sponge being reapplied as often as signs of consciousness return.

The effects of anæsthetic inhalation have been well described by Dr.
Warren, as follows:—

"On inhaling ether, the patient's respiration is at first short and quick,
and apt to be followed by a cough or gasp, which induces the patient to
refuse the inhalation.    When the ether is combined with chloroform in the
proportions above mentioned, this temporary irritation is less frequently
noticed.    The bronchia becoming accustomed to the vapor, the respiration
becomes fuller and slower, till at last the inspiration is taken to the fullest
extent, when, as etherization is induced, it becomes slower and comparatively
feeble.

" The pulse at first is quickened, but soon begins to diminish in frequency,
and ultimately becomes slow, till it counts even as low as forty or fifty in the
minute.

"As soon as the pulse begins to diminish in frequency, the inhalation may
be checked, and the soporific effect of the vapor carefully noted.    The face
and neck will soon be seen to become flushed and heated, and the action of
the heart to be strong and vibrating.    The conjunctiva is also apt to become
temporarily injected, the eye vacant and listless, and the patient soon loses
all control over vision.

" The muscles are often excited at first, and their increased action some-
times makes the patient troublesome until perfect etherization is induced."*
But with the mixture of one part of chloroform and five of ether, just referred
to, this muscular excitement is less frequent.    In either case, however, a

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* Etherization, by John C. Warren, M.D., Boston.

serious operation should not be commenced until this stage has passed, and a slight continuation of the inhalation will soon remove it.

"Simpson, of Edinburgh, has observed that, to produce the full and perfect effects of etherization, the following conditions are necessary : First, the patient ought to be left in a state of absolute quiet and freedom from mental excitement, both during the induction of etherization and during his recovery from it. All talking and questioning should be strictly prohibited. Secondly, the primary stage of exhilaration should be entirely avoided, or at least reduced to the slightest possible limit, by impregnating the respired air as fully with the ether vapor as the patient can bear, and by allowing it to pass into the lungs both by the mouth and nostrils, so as to superinduce rapidly its anæsthetic effect."*

The quantity of ether necessary to induce anæsthesia will depend in a great degree upon the peculiarities of individuals. Females, and especially those of a nervous temperament, require a much smaller quantity than males ; and among the latter, those accustomed to the free use of ardent spirits will require more than those who are temperate. Hayward, of Boston, who was among the earliest of those who administered ether by itself, states† that, in operations which require from five to ten minutes for their performance, he has found from three to six ounces sufficient, if the ether is of the purest kind, (rectified ;) but that a much greater quantity may be used with perfect safety, and the patient kept under its influence a longer time without danger, by removing the sponge occasionally, and reapplying it when sensibility is about to return. The same surgeon also states, as evidence of the safety with which ether may be thus administered, that he has given it to "infants of seven weeks old and to individuals of seventy-five years, with entire success. He has also administered it to persons suffering under chronic pulmonary disease, not only without injury, but in some cases with decided benefit. In fact, he hardly knows a state of the system in which he would be deterred from using it, if called on to operate." Though a warm advocate of the safety of ether, Hayward objects to the use of chloroform and of chloric ether, on account of the poisonous effects which he thinks are peculiar to chloroform.

Lente, of New York,‡ in view of the alleged frequent fatality of inhalations of chloroform, advises the use of *pure sulphuric ether ;* stating that this anæsthetic has been employed in the New York Hospital for six or seven years, and that he has been in the habit of using it largely in private practice, while up to the present time no instance of fatal result has been recorded from the use of sulphuric ether.

As it is of great consequence that both ether and chloroform, when employed, should be as pure as possible, the surgeon will do well to try the following processes before applying any parcel that may be obtained from a druggist :—

**To test the purity of Chloroform,** Fleming, of Dublin, recommends that chloroform should first be tested by holding a piece of litmus-paper over the mouth of the bottle. If the vapor reddens or bleaches it, the article is unfit for inhalation. He next drops a little chloroform into a glass containing water or a solution of nitrate of silver. If the chloroform remains like a transparent globule at the bottom of the glass, it is good ; but if the globule

* Simpson on Anæsthesia, p. 27.

† Remarks on the Comparative Value of Different Anæsthetics, Boston Med. and Surg. Journal, 1850.

‡ New York Journal of Medicine, vol. xv. p. 195.

appears like a muddy lens, or becomes opalescent, it is adulterated, and unfit for inhalation.*

In order to enable a surgeon to resort to the common ether when he is unable to obtain the purer article, the following process for washing and testing it is given :—

**To wash Ether.**— Pour the ether (say six ounces) into a large bottle, and add about half a pint of water; then agitate them by shaking the bottle, and pour all the contents into a filtering glass, or decant the ether carefully. The ether, being only slightly soluble in water and lighter, will float, and may be readily poured off, while any alcohol it may contain will unite rapidly with the water, and sink with it when the agitation ceases. If any sulphuric acid is present, litmus-paper, dipped in the ether, will be reddened; but if it is free from acid, the paper will remain unchanged. If the ether, when poured on a cloth and allowed to evaporate, leaves much odor, it is impure.†

The following rules in relation to the use and administration of anæsthetics, suggested in a valuable report " On the Utility and Safety of Anæsthetic Agents," embrace so much that my own experience has confirmed, that I enumerate them, in a condensed form from the report of a committee consisting of Drs. Bolton, Gibson, Cunningham, and Parker, of Richmond, to the Medical Society of Virginia, with a few additions :—

1st. Test the purity of the article to be employed.

2d. Examine the general condition of the patient. Organic disease of the heart or lungs, and a tendency to apoplexy, generally contra-indicate the use of anæsthetics.

3d. Place the patient in such a position—recumbent or reclining, if possible—that the vapor may gravitate toward the mouth. The relaxation of the muscles consequent on anæsthesia also forbids the upright position.

4th. Avoid administering anæsthetics on a full stomach, as it delays anæsthesia, and nearly always causes, subsequently, profuse vomiting.

5th. See to the introduction of a full supply of fresh air with the vapor of the anæsthetic.

6th. Secure complete anæsthesia before commencing a serious operation, and maintain it during its performance.

7th. Pay more attention to the effect than to the quantity administered, except in using chloroform, when more than half a drachm at a time is often hazardous, as the effects are cumulative and very sudden.

8th. Let it be the special business of an assistant, who has experience in the administration of anæsthetics, to attend to the etherization.

9th. Always have a bottle of strong aqua ammonia at hand, as well as a basin of cold water, in case of accidents.

**Means to be employed to resuscitate a patient when overdosed by an Anæsthetic.**—Although I have never seen any cause for apprehension in the use either of pure ether or ether and chloroform when combined in the proportion of five of ether to one of chloroform, yet as the accident may happen, and as it has often happened where chloroform alone has been employed, a brief reference to the best means of resuscitating a patient, may save life, by aiding the inexperienced in their efforts.

1st. Thrust the forefinger into the top of the larynx, and remove the epiglottis from it, if spasmodically closed.

2d. Practice artificial respiration by pressing alternately on the chest and belly, so as to excite the diaphragm, and then breathe into the patient's

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* Etherization in Surgery, by Dr. Fleming. Dublin, 1851, p. 52.
† Jackson on Anæsthetic Agents.

mouth, while his larynx is gently pressed back to the front of the vertebræ so as to close the œsophagus and prevent the air passing into the stomach.

3d. Apply strong aqua ammonia, on a sponge, to the nostrils, as soon as the patient gasps, or before this, if the effort is not soon made.

4th. Dash cold water suddenly on the face, top of the chest, and head.

5th. Have ready, especially in hospitals where anæsthesia is frequently resorted to, an electro-magnetic apparatus, by which muscular action may be sustained in the heart and chest. In applying it, place one of the electrodes over the phrenic nerve at the point where omo-hyoideus muscle crosses the sterno-cleido mastoideus, while the other electrode should be firmly pressed into the seventh intercostal space, alternating the application of each so as to create a shock.

These rules embody the most useful means of resuscitation, and are thus briefly stated in order to facilitate their remembrance when needed.

**Effects which sometimes ensue on the use of Anæsthetics.**—Some patients, on recovering from the state of anæsthesia, resemble the maudlin condition of a man half drunk, and are either very merry or very sad, jocose or sorrowful. Females also often present symptoms of hysteria, and this condition may last twenty minutes, or more, though it is not always seen. Rapid and even rough sponging of the face and head, together with the admission of an abundance of fresh air into the patient's lungs, will generally promptly remove it; if not, a little time will. If, however, the patient has been kept perfectly quiet, and the etherization has been judiciously conducted, that is, not pushed too rapidly, and to the exclusion of the proper amount of fresh air, this state will be less frequently noted. If the stomach has been kept empty prior to etherization, nausea or vomiting will also be rare; otherwise, it will frequently supervene. When it does, it may be most promptly relieved by giving free draughts of warm water, to evacuate the contents of the stomach; after which, the organ will generally remain quiet. In most instances, however, anæsthesia is not attended by inconvenience, and these effects will be found to be due either to individual idiosyncrasy, or, more frequently, to the surgeon's inattention to the administration of the anæsthetic, especially in connection with the use of food. The stomach must be kept empty, if headache or other inconvenience is to be avoided.

**Other means of inducing Anæsthesia.**—M. Velpeau recently stated in the Academy of Sciences of Paris, that M. Broca had discovered a new mode by which anæsthesia may be induced for surgical purposes. Place before the face of the patient, between his eyes and at a distance of 15 to 20 centimetres, a rather brilliant object. Make him look fixedly at it. In a few moments he will squint, will soon fall into a cataleptic condition and be deprived of all sensibility.

Three out of five attempts are reported as successful, the insensibility lasting in one case, in which an abscess was opened, 10 or 15 minutes after the operation, the patient being entirely unconscious of all that had taken place.*

**Local Anæsthesia.**—In 1852 Dr. Arnott, of London, advised the local application of a frigorific mixture of a benumbing or congealing temperature as a local anæsthetic, and as a valuable means of treating inflammation and arresting the progress of diseased action. In its use he combines finely-powdered ice and common salt, and applies it to the part in a net of thin gauze or bobbinet, or in circumscribed parts by means of suitable tubes. Its remedial action and anæsthetic effects are prompt and innocuous unless kept on so long as to kill the part entirely. When applied, it should be held in

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* Maryland and Virginia Medical Journal, January, 1860.

contact with the part from one to two minutes. At first the sensation is that of cold, then of insensibility, if local pain previously existed; the circulation is momentarily increased, and there is a red blush on the skin; which is soon succeeded by contraction of the superficial vessels and extreme whiteness of the skin, this being followed by congelation of the adipose tissue and insensibility of the part. At this moment the skin may be incised and the adipose tissue cut like tallow, without hemorrhage and without pain.

In removing small superficial tumors, amputation of toes, and evulsion of the toe-nail, I have employed this local anæsthetic with much satisfaction. It might be supposed that the reaction would develop high inflammatory action, but experience proves the reverse, and as a means of averting pain this mixture is therefore well worthy of trial.

Dr. L. A. Dugas reports the removal of a fungous growth about the size of two fists from the right arm, the freezing mixture being used as a local anæsthetic. "The patient experienced so little pain that he now declares that the most unpleasant part of the operation was the dressing, or rather the application of the adhesive strips."*

The same surgeon reports the removal of a lipoma, "about the size of a woman's fist," from the leg of a negro boy fifteen years old. The patient declared himself to be totally unconscious of the incision. In this case the freezing mixture had been applied for *four minutes.*†

The local arrangements requisite for the performance of the operation should next claim attention—such as the preparation of the parts to be operated on, and the employment of the measures likely to facilitate its performance. These measures may be summed up in two rules: 1st. To remove everything that can impede the operative proceedings. 2d. To employ such means as will especially facilitate them.

In observing the first rule, the operator must necessarily be directed by the peculiar circumstances of the operation: thus, a contracted pupil will interfere with the operation for cataract; a distended rectum increase the dangers of lithotomy; while the presence of hair about the part may render the dressing difficult, cause irritation from discharges, or possibly lead to erysipelas. The removal of all unnecessary clothing, and especially of any that is tight at the neck, as close-fitting jackets or shirts; the cleansing of the part from plasters and poultices; and the employment of such means as will tend to secure the safety of adjoining organs, or render those operated on more prominent, as the injection of the bladder in lithotomy and lithotripsy, or the retention of urine in similar cases, are also important. Under the second head, or the direct efforts likely to facilitate the accomplishment of the operation, may be placed attention to such a position of the part as will tend to drain it of blood—as in large pendulous tumors or diseases of the extremities, where the elevated position will often prevent much unnecessary depletion; the selection of such a position for the patient as will guard against faintness, unexpected movements, etc.

### § 2.—Duties during the Operation.

The duties of a surgeon during an operation embrace two distinct portions: first, those which are requisite for himself, and which, as he acts solely for the benefit of the patient, may be justly placed in the front rank;

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* Southern Medical and Surgical Journal. vol. xi. N. S. p. 79, 1855.
† Southern Medical and Surgical Journal, vol. xii. N. S. p. 58, 1856.

and, second, those demanded for the comfort and safety of the individual operated on.

Among the first of the surgeon's duties to himself, during an operation, is certainly a perfect degree of preparation for the act which he is to execute.

In addition to such professional acquirements, as a knowledge of structure, and mechanical skill as an operator, he should also, in capital operations, or those of great delicacy, give some attention to the state of his own system. Without a sound condition of his own body, no surgeon can be fully prepared to operate upon that of another. Let him, therefore, at least for some hours previous to an operation, abstain from every act, article of food or drink, that can in any way tend to derange his nervous system. Let him secure a proper amount of sleep on the previous night, and, if he desires to have the most perfect control of his fingers, let him also abstain from anything like violent muscular effort immediately before his appointment. The mere exertion of lifting the patient, or of driving a hard-mouthed horse, will in some persons be quite sufficient to impair the entire command of their muscles, though others of a coarser mould may possibly find such attention to personal details perfectly unnecessary.

It may also, perhaps, be thought useless to refer to the propriety of abstinence by medical men from nervous stimulants, on all occasions ; but, as steadiness of hand is peculiarly important to a surgeon, attention to such a point is especially necessary previous to an important operation, and this is not gained by a "preliminary dose of brandy."

While operating, the surgeon should endeavor to have his eyes and ears, as well as his hands and brain, fully ready for every event ; and so intent will a good operator be upon that which he has to perform, that it often happens he is perfectly unaware of the patient's cries, or of affairs passing around him until he has accomplished his object. In the event of any unexpected change, either in the tissues through which he is cutting, or variation in the character of the complaint which he intended to treat, he should always endeavor to remain perfectly self-possessed. If a large vessel suddenly springs, let him remember that it is only necessary to compress it with his finger until it can be tied with a ligature. If a tumor has deeper attachments than was anticipated, he has only to free it from these parts, instead of those for which he commenced his operation ; if it proves to be of a different character from what it was supposed to be, let him think that he can accomplish this new affair as readily as that which was at first proposed. If his hydrocele, on being tapped, prove to be a sarcocele, let him, if necessary, at once proceed to the extirpation of the testis ; but under no circumstances let him for a moment suppose that anything has occurred which his skill and coolness cannot remedy. If the patient faints he knows that it is a simple matter, and that lowering the head, and stimulants, will soon revive him. If convulsions supervene, as in trephining, is it not an additional reason for the more prompt application of the remedial measures ? If, unfortunately, air enters into a large vein, will not the prompt pressure of the thumb arrest its progress to the heart, and subsequent manipulation expel it from the vessel, or prevent serious injury, as in the case reported by R. D. Mussey, of Cincinnati, in which the effects of the entrance of air into the subclavian vein was relieved by the application of stimulants to the nostrils ?* In fact, let what will occur, the surgeon who undertakes an operation is totally unfit for his duty if he cannot, by these or similar views of serious difficulties, preserve sufficient equanimity to meet them. Although he may not be able to acquire the entire philosophy of the Stoics, some cultivation of it is certainly

* Am. Journ. Med. Sciences, vol. xxi. p. 332, Phila. 1837.

desirable, and such stoicism is not rashness, nor yet total indifference, but only that state of mind which the French have justly termed "sang froid," a phrase which presents us with a most apt expression of the consummate coolness that always characterizes a good operator. How to gain it, cannot be told. In some men it is intuitive; but it may also be most certainly acquired by practice; and nothing within my experience is more conducive to it than the fact of an operator duly weighing beforehand every accident that can possibly, not probably, happen. When prepared for danger, it loses more than half its paralyzing power. When a young surgeon—wanting in experience of the changing scenes or excitement often noticed during an operation—is so situated that he can avail himself of the lessons furnished by observation of the habits and course of action of his seniors, he should seize them promptly, for they possess a value which naught but subsequent practice will enable him justly to estimate.

Another portion of the surgeon's duties, during an operation, will be found in the various positions and manœuvres he will be required to execute, all of which should be duly settled before he commences. Thus, in an amputation, he should settle in his own mind which position will give him the most perfect control of the patient's limb, or on which side he can most conveniently dissect out a tumor; in what manner he will remove a stone, or ligate an artery; what shall be the position of the patient, and what the position of the assistant, so that each detail shall be fully weighed. But as such arrangements vary much under different circumstances, the further consideration of them can be best given under their proper head.

During the operation, the surgeon's duties to the patient are very much limited to those just enumerated in connection with himself. The assistants must necessarily do much toward attending to the patient's comfort and relieving his wants; they should watch the hemorrhage, and revive or restrain his irritability according to circumstances; while the operator, by leaving such duties to them, may confine himself strictly to his own acts, or when anæsthetics are not employed, encourage his patient by voice and manner as he proceeds.

The duties of assistants are so varied as to require special consideration.

### § 3.—Of the Duties of Assistants in Operations.

The number of surgeons to be found in any district not embracing a city being generally limited, it follows that in most instances when one is called on to operate, he must look to his brother practitioners for assistance. Every physician, should, therefore, if only from philanthropic motives, endeavor to qualify himself for the performance of such offices; and the duties of assistants, under these circumstances, may therefore justly be specially studied.

To act as an assistant to the greatest advantage, it is requisite that the general object of the operation, as well as the peculiar views of the operator, should be thoroughly understood previous to its commencement. Every medical man will, of course, possess a knowledge of the first; but if time or want of practice has impaired his recollection of the details of his surgical studies, he should never hesitate to request the operator to designate the steps of the operation, and also to specify particularly any peculiarities that are likely to arise in its progress. The object of each operation being usually of a definite character, it is not easy to lay down such rules as will be invariably applicable; yet as there are many points in which all operations are alike, it is easy to systematize the duties of assistants at all opera-

tions, and then specify a few of those of most importance, as their observance will add to the comfort of all concerned.

1st. Every assistant should endeavor so to identify himself with the operator, as to act solely under his will. This, of course, requires a full explanation on the part of the operator of his views, etc. previous to the operation.

2d. Each assistant should learn what are his own peculiar duties, and confine himself solely to them.

When each assistant is thus informed there can be no confusion. Should an accident occur, the quiet of the assistants, and their attention to their own duties, until called on by the surgeon to do something else, will then aid very materially in combating it : and if this sort of discipline was more generally observed at all operations, it would prove highly serviceable. When each man is at his post, every duty can be well and quickly performed ; whereas when each one endeavors to do everything himself, all are apt to add to the confusion.

3d. Each assistant should, in every case, remember that the responsibility of the operation rests with *the operator alone*, even although the patient may have previously been under his special care.

4th. Every assistant should preserve silence, and never make a suggestion as to the operation after the first incision, unless directly inquired of by the operator. With a good surgeon such a rule would be useless; but occasionally the superior knowledge of an assistant might tempt him to violate it. In all operations with a good surgeon, every assistant feels that he is a necessary part of the scene, the events of which, though calmly directed by the operator, could not be thus managed without his assistance ; but with an inexperienced surgeon, though the assistant is of greater consequence, his true position may not be so apparent. Let the latter, therefore, understand correctly the relative value of his duties under all circumstances, and endeavor to realize that the success of every movement depends mainly on the surgeon's individual effort, and that *he* directs and is responsible for everything. As the limbs to the head, so are assistants to the surgeon ; disturb either, and the value of both is impaired.

In order to illustrate more directly the importance of the part often played by the assistant in operations, and the effect upon the operation itself, I would mention two out of the many cases that could be cited on the same point.

In the one, a distinguished French surgeon was extracting a cataract, and after lacerating the capsule of the lens, raised the flap of the cornea to permit its escape, when he received in his hand the whole contents of the eyeball, solely because of the ignorance of his assistant as to his duty in holding the upper lid, and his anxiety to see the operation. In the other case, an operation for lithotomy was delayed many minutes after the perineum was cut, simply in consequence of the assistant not knowing how to hold the staff and desiring to present it more freely to the surgeon ; the operator being compelled to stop and show him how to hold it. Not only the comfort, but also the safety of the patient, therefore, will often be found to rest on the observance of these or similar rules ; and attention to them consequently becomes a matter of serious importance to all parties.

### § 4.—Duties after the Operation.

Notwithstanding the possession of all the qualifications and skill which have been detailed as essential to an operator, the best operations will be

likely to fail, unless the surgeon is also equal to the performance of the
duties which ensue upon its completion. The proper application of the
dressings; the judicious employment of remedies to counteract the violence
necessarily caused by the operation; the arrangement of the bed, the posi-
tion of the patient and of the part operated on; the resort to stimulants,
the encouragement of sanguine anticipations; the calm of sleep, together
with diet, etc., are but a few points to which his attention must now be given.
To the well-educated surgeon, reference to such details may seem to be a
work of supererogation; but to the less accomplished or experienced oper-
ator, or to practitioners whom circumstances compel to act the part of a
surgeon, the recapitulation may not be without its value. As a general rule,
most of these duties may be summed up under one direction, to wit: the
observance of such a course of treatment as any good physician would natu-
rally direct, even if not possessed of surgical experience. A few of them,
however, which embrace matters essentially surgical, seem to demand a closer
examination, especially the employment of stimulants, diet, and exercise.

In respect to stimulants and diet, as all rules must be dependent on the
object to be attained by the operation, it becomes difficult or impossible to
establish any one law which will be applicable to every case; and yet a mistake
in relation to this most important part of the after-treatment may cause the
failure of all previous arrangements. It may, however, be said that, gener-
ally, an operator will not err in this part of his duty if he bears in mind the
great principles of all sound practice, viz., the treatment of inflammation.
Is the wound to heal by the first intention, or by granulation? Is the object
of the operation to be attained by exciting inflammation, or will its develop-
ment destroy the result? Is the action to proceed simply to the production
of lymph, or to suppuration? Is the exercise of the part operated on essential
to its cure, as in strabismus, or is its perfect rest necessary to success, as in
false joint? These and similar interrogatories will soon settle the doubts of
any well-trained medical mind in these details.

As respects the proper diet of a patient after an operation, much will of
course depend upon the replies made to the above questions; but in many
operations, such as amputations, removal of tumors, and resections, where
moderate vascular excitement is not likely to result in hemorrhage, a surgeon
will be very liable to error if he invariably places his patient upon a restricted
diet, either before or after the operation. In some instances, and especially
in advanced life, the change from ordinary food to a low diet is alone suffi-
cient to disorder the digestive organs, affect the circulation, and derange the
nervous system, even where no other cause is liable to act on the patient's
general health. How likely, then, is it to do harm when, in addition to
change of diet, the shock of an operation is conjoined with the other per-
turbating causes! In most instances, and especially where common prudence
does not clearly demand it, the operator should therefore make no other
change in the previous diet of his patient than simply to restrict the quan-
tity. Indeed, in some instances even this will do harm, especially if it is
combined with purging. An increase both in the quality and quantity of
the nutriment, under certain circumstances, often proves not only useful, but
absolutely necessary, especially if strict attention is at the same time paid to
the regular daily alvine and urinary evacuations. In many instances I have
known patients to become feverish, irritable, and have a furred tongue while
on low diet, or being purged, who were promptly relieved by quinia, porter,
and beefsteak. A full diet will not answer as a universal rule; but, with
attention to the state of the system before the operation, to the wasting effects
of the disease or of the wound, and especially to the purely local disorder
caused by a certain class of operations, good diet will prove most useful, and

the continuance of nutritious food after an operation be more serviceable than the ancient practice of depletion before, and low diet for three or five days subsequently.

In recommending a fair or even full diet—that is, a moderate allowance of meat and ordinary food—after operations, I do not wish to do more than suggest its value; circumstances must restrict its application, and in some instances do this very rigidly, as after trephining, in cataract, and in hernia. But in operating for the removal of tumors in the breast or extremities, or in the case of patients who, while in full health, are suddenly injured, and especially in operations consequent on chronic diseases, a moderate amount of ordinary animal food for the first three days, and then a tolerably full diet, will often prove most conducive to a successful result, particularly when employed with judgment.

The propriety of administering a purgative at an early period after the performance of a capital operation is also a question which must be decided by the peculiarities of each case, and perhaps also by the personal experience of the operator. Like diet, purging is a point of treatment that cannot be regulated by any universal rule, but it will generally be found to be good practice to keep the bowels free after an operation, but not to purge; these remedies having usually been sufficiently resorted to prior to operating.

## SECTION II.

### PREPARATION OF INSTRUMENTS.

Although a good operator can doubtless accomplish his object with any instrument that he can obtain, yet few would desire to neglect, or be justified in neglecting, the attentions referred to under this head. A common instrument, with a skillful workman, will do more than the best one that can be placed under the direction of an ignoramus; but even a skillful workman will obtain a more perfect result by collecting and preserving such tools as are requisite for his daily wants.

In this division of his general duties, the surgeon's attention should therefore be bestowed on the selection, preparation, manipulation, and preservation of his "mechanical therapeia."

#### § 1.—Selection of Instruments.

In selecting his instruments, every operator must be mainly guided by the wants of his own position. As a general rule, his attention should be first bestowed upon the character of the steel, its temper, finish, and shape. Very many of those who begin life in expectation of devoting themselves to surgery, commit the mistake of purchasing a cheap article instead of a good one, and soon have reason to repent of their bargains. Poor steel cannot be made to keep an edge, and constant sharpening, independently of the difficulty arising from want of skill, soon renders it useless. Good steel is a more costly article at first, but the cheapest in the end.

#### § 2.—Preparation and Sharpening of Instruments.

Where an operator is so situated as to be able to avail himself of the services of a cutler, this portion of his duty may be advantageously placed

# PLATE I.

A VIEW OF SOME OF THE INSTRUMENTS EMPLOYED IN MAKING INCISIONS AND DISSECTIONS, IN THE EXTIRPATION OF TUMORS AND THE LIGATURE OF ARTERIES.

These instruments are drawn about one-half the natural size and from the most approved patterns.

Fig. 1. Small-size Scalpel for delicate work.

Fig. 2. Operating Scalpel, medium size.

Fig. 3. Operating Scalpel, larger size.

Fig. 4. Operating Scalpel, of greater strength.

Fig. 5. The Silver-grooved Director. This instrument ought always to be sufficiently soft to admit of its being bent when desired.

Fig. 6. Straight sharp-pointed Bistoury.

Fig. 7. Curved sharp-pointed Bistoury.

Fig. 8. Cooper's Hernia Bistoury.

Fig. 9. Probe-pointed curved Bistoury.

Fig. 10. Position of the Scalpel on the Hone in the first motion toward Sharpening.

Fig. 11. The second Position of the Scalpel in Sharpening.

Fig. 12. Savigny's Tenaculum for Ligating deep-seated Arteries.

Fig. 13. Ordinary Tenaculum. This instrument is generally too much curved, and the present one has, therefore, been carefully selected.

Fig. 14. Horner's Aneurism Needle. A slip-knot is placed on the shoulder at 1, and carried around the artery without creating any obstruction from the thickness of the ligature.

Fig. 15. Liston's "Bull-dog" Forceps.

Fig. 16. Torsion Forceps.

Fig. 17. Ordinary Dissecting Forceps.

Fig. 18. Polypus Forceps.

Fig. 19. Tumor Forceps.

( 180 )
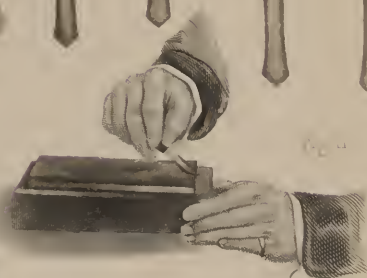
in other hands; but, under different circumstances, or where he desires to save expense, he will soon find it an easy matter to accomplish perfectly the sharpening of the greater portion of his own instruments, and especially those which are in most constant use.

Preparatory to attempting the sharpening of any instrument, it is necessary that the principle of its action should be thoroughly understood, and that a good stone be obtained, as well as a strop or piece of soft leather.

The action of every knife is beyond doubt the same as that of a saw. No matter how fine the edge of a knife may be, a magnifying glass will show points corresponding with the teeth of a saw; and a saw, to cut well, must be set so as to act chiefly in the reverse direction to that in which it is drawn, seldom cutting both up and down with equal facility. The teeth in the scalpel being intended to cut by being drawn over the tissue, in a manner similar to the upward motion of the saw, their edge should be set forward in sharpening, or from the heel to the point. In the application of the blade to the stone, such motion must therefore be given to it as will draw its cutting surface in this direction, the blade being kept at an angle of from 5° to 15° with the surface of the stone, so as to create the proper edge, and yet preserve the polish of the instrument. Every knife being also more or less wedge shaped, that is, thick upon its back and tapering to its edge, the sharpness of the wedge will constitute the keenness of the blade. The flatter, therefore, the blade is placed, provided it is not below 5°, with the surface of the stone, the more delicate will be the angle produced in the friction of sharpening, while the more elevated the back, the greater the pressure on the edge; so that, after this elevation passes an angle of 20°, it will be apt to result in a blunt, rounded, or dull surface. When, then, with a good stone—and in the United States there is nothing superior to those of Arkansas or Missouri—the operator wishes to give his scalpel a keen edge, let him proceed as follows :—

Place the blade very nearly flat upon the surface of a stone, which has a smooth and well-ground face, after it is lubricated with oil, and, holding the handle with the hand in a state of semi-pronation, push the blade, with its edge forward, across the stone, Plate I. Fig. 10; then turning the hand into semi-supination, draw it from heel to point with its edge toward the operator, over to the point of departure, bearing on lightly or heavily, according to the amount of grinding to be accomplished, Plate I. Fig. 11. As a general rule, the harder and closer the grain of the stone, the flatter the blade is applied to it, provided it is not below 5°; and the lighter the pressure, the keener and smoother will be the edge. After repeating these movements until an edge is obtained—as may be tested by shaving the thick skin on the palm of the hand—draw the blade upon the strop or leather in the same manner as razors are sharpened for daily use, and in the reverse manner to that employed on the stone, that is, with the back of the blade presenting to the most distant end of the strop.

In sharpening pointed instruments, such as cataract needles, trocars, and gorgets, the same principles hold good, although some extra attention to the shape and character of their cutting surface will be required in order properly to adapt them to the stone. As a trocar acts very much on the principle of the chisel, the mode in which that instrument is sharpened by the carpenter will answer, provided the point is kept flat to the stone—and the same manœuvres will be applicable to cataract needles and gorgets, when the edges have become very round ; but under other circumstances it will be better to manipulate with them in the manner described in sharpening the scalpel.

When an instrument has acquired a rounded and blunt edge, grinding will

generally be found necessary, and, in most instances, this should be confided
to the cutler, though the surgeon may approximate the same end, by steadily
rubbing the blade upon a coarse stone, and then proceeding to finish its edge
by using one that is finer, or even a strop.

### ﹩ 3.—Manipulation of Instruments.

Few of the qualities of an operator are more quickly noticed by a spectator
than the facility or even grace with which his movements are executed. But
although this ease in manipulating is highly advantageous to the patient and
a valuable accomplishment to an operator, directions in regard to it would
be out of place at present, and can be more readily comprehended in connec-
tion with each operation.

The principles which should govern the movement of cutting instruments,
in all operations, may, however, be briefly noticed.

Scalpels, bistouries, and amputating knives, acting simply as saws, will be
found to cut with the greatest facility when drawn regularly, and with
moderate but steady pressure over the part to be divided.

When, in using a scalpel, it is desirable to make a clean and smooth cut,
the motion given to the instrument should be one chiefly of traction, effected
by flexing and extending the thumb and fingers in very much the same manner
that a pen is moved in writing, any great amount of motion in the wrist or
downward pressure being unnecessary.    Indeed, as a general rule, the wrist-
joint should never participate in the motion of a scalpel, except when it is
requisite to change the course of an incision, or make it of extraordinary
length, and even under these circumstances a neat manipulator will seldom
feel the necessity of moving it.    If the wrist is permitted to take part in
the movement of dissecting, chopping or hacking of the tissue will usually
result, or such a division of parts as might be effected by an axe but not by
a saw.

Scissors, being formed of two blades, are designed to act like two scalpels
pressed together; consequently, in dividing very dense structures, a slight
drawing motion enables them to cut better and with less contusion of tissue,
than the exercise of any great amount of force in closing the blades.

Instruments specially required for punctures are fortunately few in number.
Like the chisel, they necessarily compress or contuse the parts at their point
of entrance, and should, consequently, always possess a keen edge and be
introduced gradually.    The stabbing motion sometimes given to trocars or
gorgets is usually indicative of ignorance of these principles on the part of
the operator, and nearly always induces more or less sloughing at the point
punctured.    A sudden elevation of the operating hand from the surface on
which it should be supported is also an error occasionally apparent in
operators when using the scalpel, and especially of such as study the art of
manipulating with a view to the gracefulness of the movement, rather than
as an auxiliary to the perfect action of the instrument.    Like a similar mo-
tion on the part of pianists, it may be deemed captivating to the observer,
but as it necessarily draws the knife from the portion on which it is acting,
it is worse than useless, and should be avoided.    A neat operator may be
characterized as a good *dissector*, who accomplishes his task with certainty
and moderate quickness; and the motions of a good dissector are certainly
not of the jumping order, but, on the contrary, result from the regular move-
ments of his fingers in flexion and extension.    All manipulation of cutting
instruments, to be well executed, should therefore be entirely accomplished
by these motions of the fingers, or by those of a hand which moves as if

balanced at the wrist. The motion of the elbow can never be required in using a scalpel, and seldom with any other instrument, except the saw or amputating knife. Great flexibility of the fingers, and the power of causing three or four of those of the same hand to perform different acts at the same moment, will also add much to the neatness of a surgeon's manipulation. Thus, the thumb and first and second fingers may hold the scalped in dissection ; the little finger serve as a point of support, and the third finger be made to stretch a tissue, hold back a flap, and serve as a fulcrum at the same moment—the difference of power possessed by some operators over others being often shown in the facility with which they accomplish these movements. A thick, clumsy, and heavy hand can never make a neat operator, though study of its motions, together with constant practice, may do much to remedy its defects. The ability to use the left hand nearly as well as the right is occasionally not only an accomplishment, but also a most useful qualification in an operator, and a little practice in the daily acts of life, as in carving or dressing, will soon enable any one to acquire it.

A few words on the action of the scalpel may be useful to the inexperienced operator. The scalpel usually employed in operating resembles in most points that generally found in the dissecting case. Its function is, indeed, the same in both instances, though in operating, as in dissecting, there is a difference of opinion as to the best shape of its blade, some surgeons preferring one that is somewhat angular toward the point, and others liking it better when made with a greater degree of convexity. In either case, the blade should be firmly fastened to the handle, and the latter made plain and tolerably smooth, not only because this is more favorable to accuracy of touch, but also because it can be more readily cleansed. On the latter account, the serrated handles sometimes placed on scalpels are objectionable.

The most common positions of the scalpel, in operating, are the six following, as employed by the French surgeons :—

**First Position.**—Hold the scalpel in the position of a carving-knife, that is, with the handle in the palm of the hand and the forefinger pressed upon the back of the blade, and make the incision by bearing firmly on the blade with the forefinger, Plate II. Fig. 1. This position gives the operator an opportunity of exerting considerable force, and is well adapted to the first incisions in dense tissues, as in excising a scirrhous breast, or in the removal of an osseous or fibrous tumor, or in the division of ligaments or tendons and muscles, in disarticulating joints. When it is desired to render the skin tense and make the external incision in a certain line, the integuments should be steadied, as represented in Plate II. Fig. 2.

**Second Position.**—Hold the scalpel with its edge upward, and, puncturing a fold of the skin, incise it from within outward, by elevating the point with the thumb and finger, pressing the handle against the palm with the other fingers, Plate II. Fig. 4. Previous to employing the scalpel or bistoury in this position, an assistant should be directed to raise a fold of the skin, so as to free it from the subjacent parts. When the integuments are thus divided, there is but little risk of injuring deep-seated parts, while less pain is caused to the patient than when the incision is made from without inward, as in ordinary dissection, or in that represented in Plate II. Fig. 2, where a fold is raised and incised from the outside.

**Third Position.**—Hold and move the scalpel very much like a pen, the point and edge being pressed downward with sufficient firmness to enable them to divide the parts to the desired extent. In commencing an incision, the point of the blade should be inserted into the tissue by a perpendicular pressure of the fingers in an extended position, and the knife drawn firmly

# PLATE II.

Fig. 1. *The First Position of the Scalpel.*—The scalpel is held as a carving-knife, so as to cut from without inward. In this position, the thumb and radial side of the second finger should be placed at the rivets in the handle, while the ring and little finger shut the back of the handle into the palm of the hand, and the forefinger rests upon the back of the blade. The further this finger is extended upon the blade, the greater will be the amount of force that can be employed by the operator.

Fig. 2. A view of one method of incising the skin with the scalpel in the First Position. A fold being raised and rendered tense by the left hand of the surgeon and the right hand of an assistant, and the incision made by cutting from without inward.

Fig. 3. Another method of incising the skin. The parts being made tense by the thumb and forefinger of the surgeon's left hand.

Fig. 4. *The Second Position of the Scalpel*, or the reverse of the first. In this position, the thumb and forefinger should be placed at the sides of the handle near its junction with the blade, and the middle, ring, and little fingers be employed in grasping the handle. A fold of the skin being raised, is to be punctured and then incised from within outward, when the knife is held in this position.

Fig. 5. *The Third Position of the Scalpel.*—In this position, the scalpel is held as a pen between the thumb and first two fingers, while the hand is supported and steadied by the other fingers. The tissues to be divided are held by the forceps, and the scalpel made to cut simply by flexing and extending the fingers.

Fig. 6. *The Fourth Position* is the reverse of the last. The scalpel being held as a pen, but with its edge from the surgeon, so as to cut only by extending the fingers.

Fig. 7. *The Fifth Position of the Scalpel.*—In this position, the scalpel is held as a " fiddle-bow," the pulps of the four fingers being extended in a line along one side of the handle, and the thumb placed on the opposite side so as to correspond with the line of the fingers. This position is a very easy one, and gives great lightness and delicacy to the incisions.

Fig. 8. *The Sixth Position of the Scalpel.*—In this, the scalpel or straight bistoury is held with the fingers flexed, and with its edge toward the hand. The left hand in this position generally holds the director, which is kept stationary, while the right passes the knife along its groove.

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toward the operator by strongly flexing the fore and second fingers, Plate II. Fig. 5, the incision being terminated by a perpendicular pressure of the blade at the point where it is wished to stop, in order to prevent the irregular scratch of the skin, or that mark which the French call "a tail."

**Fourth Position.**—Hold the knife nearly in the same position as a pen, but with its cutting edge upward, so as to cut from the operator, Plate II. Fig. 6. Both this and the third positions are constantly required in every operation in which dissection is necessary, as in the removal of tumors, ligature of arteries, etc.

**Fifth Position.**—Hold the scalpel by placing the thumb on one side of the handle while the four fingers are approximated on the other, like the position of a fiddle-bow, Plate II. Fig. 7. This position is well calculated for incisions requiring delicate touches of the knife, as in the division of tissues over hernia, large vessels, and other important parts.

**Sixth Position.**—Hold the scalpel or bistoury with its edge to the palm of the hand, so as to cut toward the operator; the tissue to be divided, if near important parts, being raised upon a director, Plate II. Fig. 8.

The multiplication of these positions of the scalpel may be carried to any extent, but those most frequently required will be found to be such as have just been detailed.

In every case where dissection is requisite, it is important that the parts to be divided should be kept upon the stretch, either by holding them with the forceps, Plate II. Fig. 5, or, where the portion is of sufficient size, by seizing them with the thumb and fingers of the hand opposite to that which holds the scalpel, Plate II. Figs. 2, 3, and 4.

Wherever, in incising the skin, it is desirable to make a regular and smooth cut, the integuments in the neighborhood should be kept quite tense, or prevented from yielding before the pressure of the scalpel, either by the operator placing his thumb on one side of the line of incision and his fingers on the other, Plate II. Fig. 3, or by employing the hands of assistants. In limited incisions, the left hand of the operator is sufficient; but in those of greater extent, as in the removal of a breast or large tumor, those of assistants will be necessary. As the first incision generally causes the flow of blood, one of these assistants may at the same time sponge the part so as to facilitate the operator's view of the structure.

Incisions may be made of various shapes: thus, a single line constitutes what has been termed a simple incision, and that formed by two or more lines a compound one. These compound incisions may be modified to any extent, but usually they are formed by the arrangement of straight lines, so as to form cuts like the letters V, L, T, or H, or as a ⊓, or as a +, or of curved lines, as the crescent ⌣, or ellipse ◯, or double crescent ⌢, Plate III. Fig. 7. By these and similar incisions, the skin may be divided into various flaps, which, being subsequently freed from the subjacent parts by dissection, will enable the operator to act according to his pleasure. An important rule in all these incisions is, *to make them sufficiently long*, or even too free at the first cut, as the skin usually heals readily, and a free primary incision facilitates very much the subsequent dissection. Another useful rule in connection with incisions—especially in parts where the cicatrix will afterward be apparent, as in the face, or on the neck and shoulders of young females—is, to make them so that the scar may come in the course of the contractions of the fibres ef the neighboring muscles, by which means the cicatrix will be hid in the natural folds of the skin; thus, on the forehead, the incision in the skin should, if possible, be transverse, so as to correspond with the wrinkles created by the occipito-frontalis muscle; on the cheeks, in the line of the

# PLATE III.

Fig. 1. Signoroni's Tourniquet, for arteries which are placed near bony depressions.

Fig. 2. Bellingham's Compressor, for the treatment of aneurisms.

Fig. 3. The Pear-shaped Cautery.

Fig. 4. The Button-shaped Cautery.

Fig. 5. Physick's Forceps and Needle.

Fig. 6. The "Spanish Windlass," or Garrot, made by twisting a handkerchief with a short stick.

Fig. 7. A front view of the Abdomen, showing the shapes of different incisions. 1. The V-shaped incision to form a single flap. The first incision being made, the second line should commence at the proper distance from the first, and terminate like the first. The flap is to be reverted from the point of the V 2. The T-shaped incision to form double lateral flaps. Make the horizontal cut, and then let the vertical incision terminate near the middle of the first cut. 3. An ⊓-shaped incision. The vertical cut being first made, the two horizontal ones should be made to terminate at each extremity. 4. The H-shaped incision. The middle or horizontal cut being first made, the two vertical ones should be carried across its ends, so as to form two broad flaps. 5. The crucial incision. This may be made either by uniting the points of two V-shaped incisions, or by elongating the vertical portion of a T. 6. The crescentic incision. 7. An elliptical incision, made by joining the ends of two crescentic cuts.

Fig. 8. Different kinds of Hare-lip Pins. 1. Three pins made of steel, or simple wire sharpened at one end. 2. The hare-lip pin with the movable point.

Fig. 9. Small-size Bone-nippers, employed to cut off the ends of the pins, etc.

Fig. 10. A peculiar form of the Continued or Glover's Suture, occasionally useful in deep muscular wounds.

Fig. 11. The Quilled Suture. 1. The wound. 2, 2. The quills. 3, 3. The sutures tied around the quills so as to approximate the sides of the wound.

Fig. 12. Several Points of the Interrupted Suture. The knots should always be tied as at *l, l, l* at the sides, and not over the line of the incision.

Fig. 13. Union of a Wound by Adhesive Strips. 1. The line of the wound. 2. The strips applied at regular distances.

( 186 )

Plate I
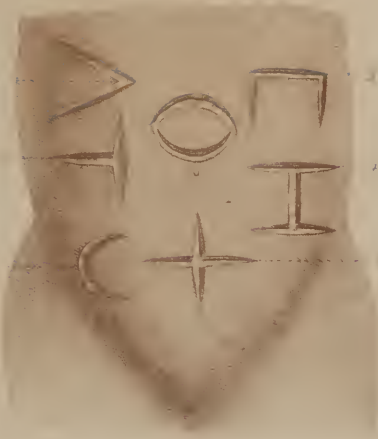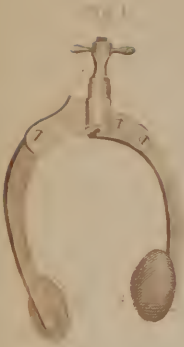
Fig. 1  Fig. 2  Fig. 3  Fig. 4  Fig. 5  Fig. 6  Fig. 7  Fig. 8  Fig. 9  Fig. 10  Fig. 11  Fig. 12  Fig. 13
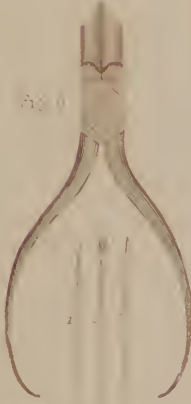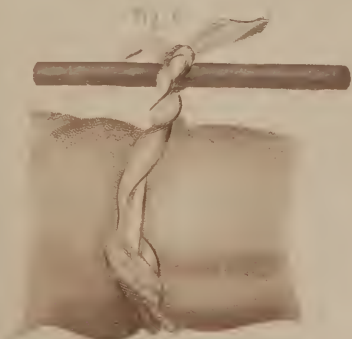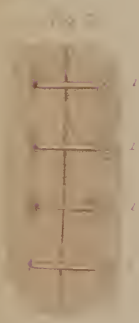
levator anguli oris or levator labii superioris alæque nasi; and on the neck, in front of or behind, but in the line of the sterno-cleido mastoid muscle.

Incisions, or the division of parts by the scissors, require but a few words, as the necessity for employing them is rarely met with. Whenever scissors are to be used for incising parts concerned in operations, they should be held by placing the last joint of the thumb through one ring, and that of the second or third finger through the other, the index or second finger being placed on the side or above the blades. The preference should, however, be given, in most instances, to incisions made by scalpels, provided there is a sufficient basis of support, as the latter will generally make a cleaner cut, owing to their being susceptible of a keener edge than scissors, which in the United States are often imperfectly made, even by the best cutlers. The incisions of bone by the saw or bone-nippers may be classed under those of the scalpel and scissors, but will be again referred to in connection with the operations on the bones.

**Dissections,** as performed by a surgeon, constitute the greater portion of his operative manœuvres; but, as they do not vary from those employed upon the dead subject, the same general rules are applicable both to them and to the ordinary dissections of the anatomical rooms. 1st. Stretch the part to be divided, and render it perfectly tense. 2d. Incise it by a long, steady sweep of the scalpel in the third position, with a motion similar to that made in forming large letters with a pen. 3d. Remove the blade of the knife as seldom as possible from the line of incision, so as to avoid scratching, digging, piercing, jerking, or notching the tissue. If, in the course of a surgical dissection, the tissues to be divided involve parts of delicacy and importance, it will be better to employ the director and bistoury, as is shown in the sixth position of the scalpel, Plate II. Fig. 8, for their incision, than to trust to the ordinary motion of the knife, unless the operator is very sure of a steady and light hand. The support of the hand to be obtained by resting the ring and little finger upon surrounding parts, in the third position of the scalpel, Plate II. Fig. 5, will, in these dissections, prove of great service.

When, in the course of an ordinary dissecting operation, small arteries are divided, it becomes a question whether the operator should stop in order to take them up, or whether he should not proceed rapidly to accomplish his object. In deciding this question, much must depend upon circumstances; but, as a general rule, if the part is superficial and the arteries of no great size, as is the case in most operations on the breast, or in removing tumors elsewhere, the surgeon may finish his dissection before attending to the hemorrhage, or direct an assistant to compress or twist the vessels as they spring, or put his finger on them; as it often happens that, before the termination of the operation, the contraction and retraction caused by the stimulus of the air, or the effect of the latter on the liquor sanguinis, will be sufficient to arrest the hemorrhage. If, in the dissection of complicated or deep-seated parts, the first assistant cannot by sponging keep the part free from blood, or if the patient will not be benefited by the depletion, then the operator had better stop and ligate the vessels before proceeding with his operation.

**Punctures.**—When tissues are divided by the direct pressure of a pointed instrument, it constitutes a puncture. Punctures may be made with a scalpel, but more frequently they are created by the use of the lancet, sharp-pointed bistoury, or trocar. In making punctures with either of these instruments, the depth may, if requisite, be regulated by seizing the blade near the point, between the forefinger and thumb.

**Acupuncturation.**—The simplest puncture that can be termed an operation is that made by the introduction of needles under the skin. With the

exception of their employment in exploring doubtful tumors, and in sutures, their use is mainly confined to what is known as acupuncturation. This consists in making a number of small punctures in the skin by means of needles of gold, silver, platina, or steel, shaped as in Fig. 130, and introduced into the part by rapidly rotating them between the fingers. Marked benefit in certain cases was said to have been derived from their use, and as they caused but little pain, the operation was at one time quite popular. Employed from an early period by the Japanese and others, in order to relieve various internal

Fig. 130.
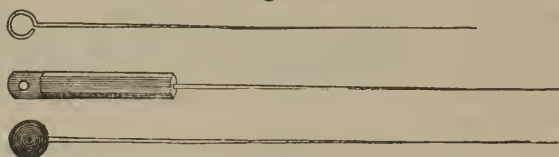
A

disorders, so rapid was their action, that miraculous powers were wildly ascribed to them. Subsequent investigations have not, however, supported this elevated opinion, and want of success has driven the operation therefore into comparative disuse. Without discussing its advantages, I shall now simply detail the manner of performing it. The place being chosen, take hold of the head of the needle, or of the handle into which it is sometimes inserted, with the thumb and forefinger of the right hand, supporting its stem with the thumb and forefinger of the left. Press it, with a rotary motion, to the depth of several inches, if requisite, to reach the seat of pain, and leaving it there, introduce several others at slight distances apart. If the needles are sharp, and rotated rapidly, the pain of their introduction is very slight, and in certain neuralgic cases especially, their use is even said to be agreeable to the patient.

But without trusting to the effects of imagination, we may have more confidence in another method of treating such patients, which has an additional recommendation in the employment of a narcotic. This consists in making numerous punctures with these needles, or with a sharp-pointed lancet, so as barely to draw blood, and then washing the part with a strong solution of sulphate of morphia, or by painting it with the strong tincture of the root of the aconitum napellus. The action of the anodyne thus brought directly to the seat of pain is said to relieve it very quickly.

The application, however, of the ointment of aconitia, or veratria, in the proportion of one grain of the aconitia to the drachm of lard, as recommended by Turnbull and others, has destroyed the pain of the most intense facial neuralgia within a half hour.

**Hypodermic Injections.**—The hypodermic administration of anodyne solutions may also be accomplished by the use of Pravaz's syringe, now generally obtainable from the cutlers. This is a small glass syringe with a fine, sharp, needle-like point, which punctures the skin, when a drop or two of the liquid is forced through the hollow needle by one or two turns of the screw attached to the piston. Anodynes thus brought directly to the seat of nervous irritation are promptly absorbed by the connective tissue-cells, and produce an immediate impression on the nerves. Care must be taken not to induce such irritation as will result in suppuration. In the case of deep-seated pain this syringe may be required; but in more superficial cases, acupuncturation, and the external application of the anodyne solution, until it is absorbed, will answer as well, and is a means of treatment more readily obtainable.

**Electro-Puncture.**—The advances recently made in the science of galvanism and electricity have again revived the operation of electro-puncture. This operation is the same as acupuncturation, so far as the introduction of the needles, but differs subsequently, in its being aided by the action of the electric fluid directly on the diseased part. In using this fluid we must of course be governed by its general laws, and if we wish to produce only slight shocks, cause the spark of the apparatus employed to fall indirectly on the head of the needle, shaped as at A, Fig. 130; but if a more severe action is desired, keep up a continual current through the needle, by direct contact with it, of the poles of the machine. The electro-magnetic apparatus is applied on the same principles as the electrical machine, that is, by forming and breaking the circuit; and it matters little in what way the fluid is applied to the needles, provided the circuit is continued throughout them, and is not kept up so continuously as to heat the needles and convert them into cauteries. The cases to which it is adapted, and their probable results, may be found fully treated of in most of our dictionaries, under this head.

## SECTION III.

### MEANS OF ARRESTING HEMORRHAGE.

After every application of the knife in operating, the necessary division of vessels gives rise to hemorrhage, which may or may not require attention before the surgeon proceeds with his operation. In the extirpation of tumors the action of the air and contraction of the vessels will frequently enable us to omit ligatures. These superficial vessels often appear to discharge blood very freely, while, in reality, the whole amount thus lost in tumor operations would not reach ten ounces, a quantity which is sometimes beneficial rather than injurious to the future condition of the patient. But if the patient is enfeebled, or the amount of hemorrhage exceed ten or twelve ounces, it will be safer to employ some means to regulate the quantity that will be discharged. These means may be classified as those which are proper before commencing the operation or before any incision is made, and those demanded subsequent to or during its performance. Among the first and simplest may be placed such a position of the part as will prevent the afflux of blood; second, compression; and third, the employment of ligatures, cauteries, and styptics.

**Position.**—The elevated position of the extremities, or such a one in tumors, etc. as will favor the return of venous blood to the heart, will always diminish the loss of blood in an operation. The selection of the position must be decided at the moment, by the peculiar circumstances of the case.

**Compression.**—The prevention of hemorrhage by means of compression is a purely mechanical result, which may be accomplished either by applying the thumb or fingers over the course of the main artery supplying the part—a mode of compression that, with good assistants or with a skillful surgeon, may be pursued with perfect success—or by the use of the tourniquet.

In practicing compression with the hand upon the arteries of the extremities, the thumb should be placed directly upon the vessel, and pressure made against the bone, by placing the thumb over the artery on one side of the limb, and grasping the other side with the fingers; or by placing one thumb on the vessel, and pressing upon it with the other, as seen in Plate IV. Fig. 7. Where the artery is so situated as to render the application of the thumb difficult, as in the subclavian or external iliac arteries, pressure may be applied by means of a common door key, well wrapped around its handle

# PLATE IV.

## ARREST OF HEMORRHAGE BY THE LIGATURE AND COMPRESSION OF ARTERIES.

Fig. 1. A side view of a stump, showing the method of ligating an artery. 1. The open mouth of the artery. 2. The tenaculum drawing the artery out of its sheath and away from the soft parts. 3, 3. The two knots of the ligature passed over the tenaculum, and about to surround the artery. Both knots of a ligature should be firmly tied upon the vessel before the tenaculum is withdrawn.

Fig. 2. The effects of Torsion upon an artery. 1. The twisted portion of the artery. 2. 2. The effects of the torsion upon the inner and middle coat of the vessel. 3. The external coat uninjured.

Fig. 3. The effects of the application of the Ligature. 1. The ligature as applied. 2, 3. The internal and middle coat cut by the ligature. 4, 5. The external coat, which sustains the ligature after the other coats are ruptured, is seen all round the vessel.

Fig. 4. The result of the application of the Ligature. 1. One of the anastomosing branches. 2. The conical clot forming in the vessel, and extending to the first anastomosing branch.

Fig. 5. A view of the enlargement of the Anastomosing branches, and of the contraction of the main trunk after the application of a ligature. The drawing represents the cure of a Popliteal Aneurism. 1. The main artery above the aneurism. 2, 2, 3, 3. The enlarged anastomosing branches.

Fig. 6. The application of the Tourniquet of Petit; a compress should be placed over the course of the artery, and a bandage carried over it, and around the limb, to prevent the strap of the tourniquet from chafing the skin. The tourniquet, with its plates closed, should then be placed directly over the compress which is on the artery, and the strap buckled tight, so that the separation of the plates, when the screw is turned, may cause the pressure of the instrument to come directly upon the compress and the artery. The pad under the buckle is solely to prevent its injuring the skin, and has nothing to do with the compression.

Fig. 7. Compression of a main artery (the femoral) by the thumbs.

Fig. 8. Surgical Curved Needles.

Fig. 9. Surgical Needles of a different shape.

Fig. 10. The Hare-lip Suture.—A. 1. The wound. 2. The introduction of the pin. 3. The twisted suture thrown around the pin.—B. The suture as completed, the integuments being protected from the pressure of the ends of the pins by an adhesive strip.

Fig. 11. A side view of a Curved Spatula. This instrument is made of copper or steel, plated, and has two curves adapted to wounds of different depths.

Fig. 12. Levret's Double Canula, with a wire ligature, applicable to polypi.
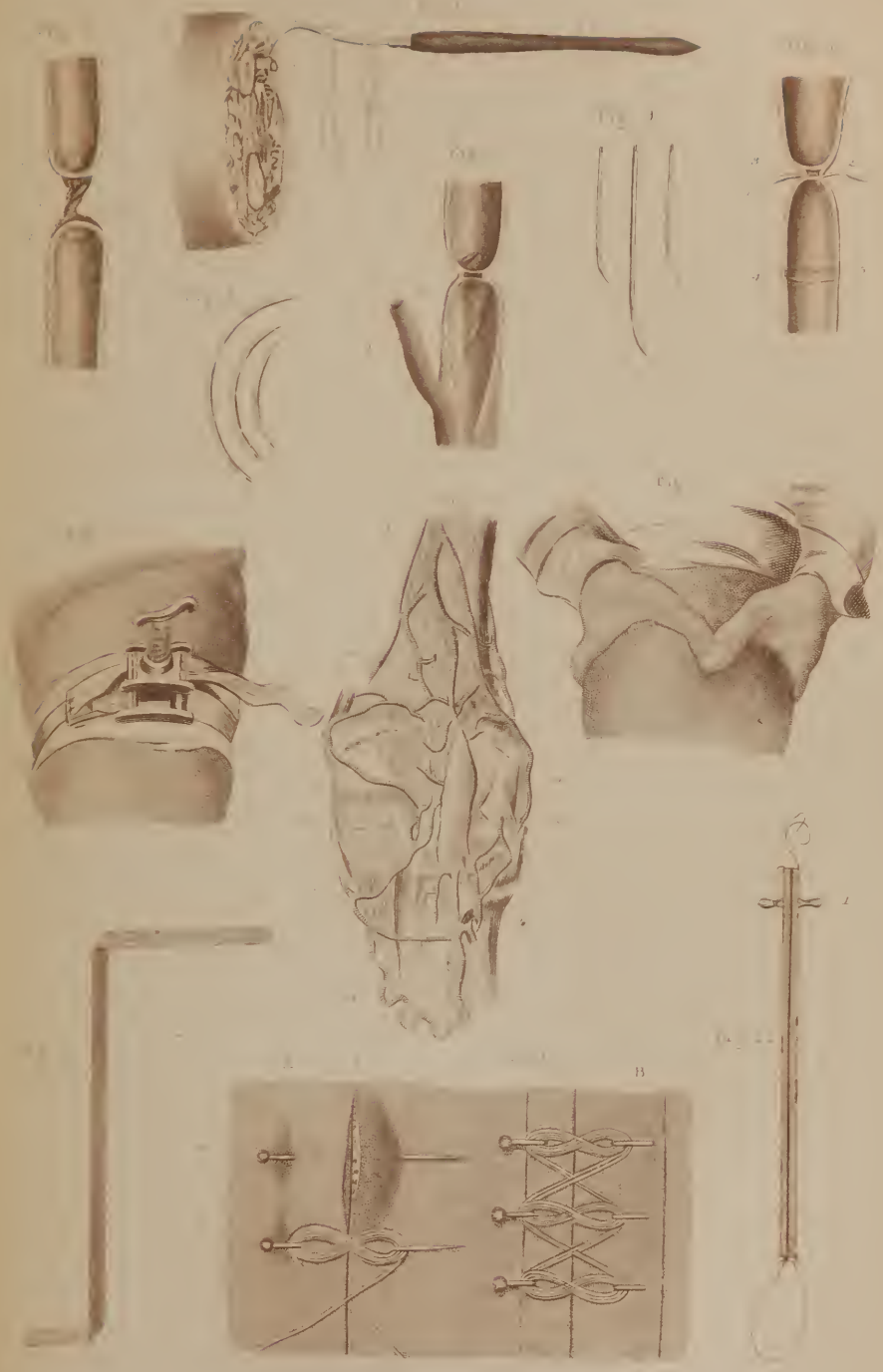
with muslin or flannel, and then placed over the artery, the wards of the key being held in the hand. The advantage claimed for arterial compression, as thus practiced, is the non-interruption of the general venous circulation of the part, the course of the blood in the artery being alone obstructed.

The next means of arresting the circulation is by the Garrot or Spanish windlass, Plate III. Fig. 6, a contrivance which, from its simplicity, has much to recommend it. It may be formed at a moment's notice, by twisting a handkerchief into a cord, tying a knot in its middle, applying the latter over the course of the artery, and then tying the free ends loosely together, introducing a stick into the loop of the handkerchief, and twisting it tight. An additional recommendation of this instrument is, that patients may be taught to employ it themselves, a matter of importance in military surgery. The tourniquet of Petit (Plate IV. Fig. 6) or Bellingham's compressor (Plate III. Fig. 2) also answer very well when applied to the extremities, and will be again referred to under the head of Amputations and Aneurisms. At present, the figures explain themselves sufficiently well. A very simple method of compressing only the arteries of a limb, and one easily practiced, will be found in the plan proposed by Dr. Physick, in the case of hemorrhage from the foot. A compress was first applied over the anterior tibial artery, and another over the posterior tibial, about two inches above the ankle; over these a strip of sheet copper or tin was passed round the leg, and then a tourniquet applied over the copper. By tightening the tourniquet the arteries were compressed, and the bleeding arrested, while the rest of the circulation was not interrupted.*

A special tourniquet, or compressor, as it has been named, has lately been brought forward by some one in the Eastern States, and is a useful instrument for the compression of deep arteries. It is figured in Plate III. Fig. 1, but is evidently a repetition of Signoroni's tourniquet, or of that of Dupuytren. It is especially applicable to the axillary and iliac arteries, or where it is desirable to compress only two points of a limb. It consists of two semicircular sections, jointed at one end, and made to move upon each other by means of a racket piece which is acted on by a key. Pads are attached to the opposite ends of each section, and they are thus made to press directly upon the points to which the instrument is applied. Compression for the arrest of hemorrhage either previous to or during an operation should, however, be applied only for a limited time, lest it induce mortification. When more permanent means are necessary, the surgeon should resort to direct applications to the wounded vessels, and employ the ligature or torsion.

Ligature.—In no instance, after a severe operation, can a surgeon feel himself secure against the risks of hemorrhage, unless he has taken care to ligate each vessel thoroughly. To accomplish this, it is necessary that he should resort to some means of seizing the bleeding orifice, such as a tenaculum, Plate IV. Fig. 1, artery forceps, Plate I. Fig. 16, or curved needle, Plate IV. Fig. 8. The tenaculum is intended to hook and draw out the vessel from surrounding parts, and is the instrument most frequently employed in this country. The artery forceps performs the same office, but is not so much esteemed on this side of the Atlantic as on the continent of Europe. The curved needle is applied to vessels that shrink in among surrounding parts, or where the bleeding orifice cannot be readily found, or where the portions immediately around the point of hemorrhage must be indiscriminately ligated in order to control the bleeding.

Without entering into the physiological effects of the application of ligatures to arteries, it may suffice to say that it is necessary, as established by

* Elements of Surgery, by John Syng Dorsey, M.D., vol. i. p. 61. Phila., 1823.

Jones,* that the ligature should be drawn with sufficient firmness to cut
through the internal and middle coat of the vessel, Plate IV. Fig. 3, and
that sufficient inflammatory action be established within the artery to glue its
sides together, and render the channel impervious.  If the artery is diseased,
care must be exercised lest the force thus applied cause the ligature to cut
through the vessel before adhesion has occurred.   In order to obviate such
an event, it has been advised to employ a broad ligature, or, as Manec sug-
gested, to introduce a piece of bougie into the vessel to diminish the pressure
upon the coats, or we may include in the ligature a portion of the adjacent
muscle.

   When an artery in the healthy condition is to be tied, the surgeon should
proceed as follows : seize the open end of the vessel with a tenaculum, by
inserting the point of the instrument into its coats, draw it out of its sheath,
and separate it as much as possible from the surrounding tissue, especially
from the accompanying nerves, Plate IV. Fig. 1.   Should the latter be
included, it may give rise to violent neuralgic pains, or create neuromatous
tumors, or by causing the ligature to remain for a long period in the wound,
interfere with the process of cicatrization.

   Then let an assistant pass the middle of the ligature beneath the tenacu-
lum, and bringing its two ends around the vessel, form a loop, and drawing
upon the ends with the fingers, tighten the knot with the points of the
thumbs, in the same manner that a cobbler draws his ends, taking care that
the knot passes below, and not above the point of the tenaculum, and that
it is drawn with sufficient firmness to accomplish the division of the arterial
coats.   A second knot being then tied in like manner, one end of the liga-
ture should be cut off within about a quarter of an inch of the knot; the
other brought out at an angle of the wound, and the tenaculum removed.
Some surgeons remove the tenaculum before the second knot is formed, but
it is a dangerous practice, exposing the patient to the risks of secondary
hemorrhage from the ligature being imperfectly applied.   Subsequently, on
closing the wound, all the free ends of the ligatures should be brought out
at the lowest point, where they will favor the escape of pus, and thus prevent
the formation of abscesses.   Various knots, some of which have been desig-
nated as the "surgeon's knot," etc., have been recommended for tying liga-
tures, but the ordinary double knot is all that is absolutely necessary in most
instances.

   The advantage of cutting off one end of the ligature will be found in the
diminished amount of foreign matter necessarily left in the wound until the
ligatures separate, and this is now the general custom of surgeons in the
United States.   "The practice of removing both ends close to the knot,
published by Haire, of England, in 1786, was adopted by Hennen in 1813,
at the suggestion of one of his associates, who believed it to have been an
American invention;"† but if this were so, it was probably at the period
when animal ligatures were used, as the practice revived by Veitch in 1806
has long been the only one employed in the United States.

   The ligature, thus applied, closes the vessel, arrests the passage of the
blood beyond it, and a clot is formed, Plate IV. Fig. 4, which, gradually
rising as high as the first anastomosing branch above the ligature, causes the
blood to pursue a winding course around it, by dilating the collateral
branches, until at last it enters the main trunk at a distance below the liga-
ture.   As this clot contracts adhesions to the sides of the artery, its more
liquid portions are absorbed, and the vessel closing upon it is soon converted

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   * Treatise on Hemorrhage and the Use of the Ligature, with Observations on Second-
ary Hemorrhage.   London, 1805.
   † South's Chelius, vol. i. p. 339, Philada. edition.

into a ligamentous cord, the amount of blood formerly transmitted through the artery being now carried by the enlarged anastomosing vessels, Plate IV. Fig. 5.

The substance of which the ligature should be made, and its mode of action, were formerly points of great interest to operators, and, under peculiar views, it was deemed necessary that they should be made of chamois skin, kid, buckskin, the tendon of the deer, catgut, parchment, or lead, as suggested by Physick, Hartshorne, and Dorsey, of Philadelphia, and Jameson, of Baltimore.* But, of late years, the simple silk or hemp thread has been found to answer every purpose, and is now almost universally resorted to.

**Torsion** is effected by seizing the end of the artery in forceps, and twisting it, by rotating the instrument between the fingers and thumb, until the internal and middle coats are lacerated, Plate IV. Fig. 2. Torsion is a favorite means of arresting hemorrhage among the French surgeons, but much observation has convinced me that it cannot be relied upon except in the case of small arteries.

The credit of suggesting torsion for the arrest of hemorrhage has generally been assigned to Amussat, of Paris, who published his account of it in August, 1829.† Bushe, of New York, disputed this claim, assigning the origin of it to Guy de Chauliac, and quoting cases of his own, where, in December, 1826, April, 1827, June, 1827, and July, 1828, he employed torsion "by twisting the cut extremities of the vessels in a square-beaked forceps, furnished with a sliding bar, and two nuts."‡ The credit of suggesting this method of arresting hemorrhage belongs, therefore, neither to Amussat nor Bushe, though the latter is entitled to the merit of having recalled the attention of the profession to this plan.

**Acupressure.**—Simpson, of Edinburgh, in December, 1859, recommended the compression of arteries by means of very sharp-pointed slender needles or pins, of passive or non-oxidizable iron, headed with wax or glass, resembling the hare-lip pin, but longer when circumstances demanded it. By passing one of these pins "*twice*" through the substance of the wound, so as to compress together, and close by the middle portion of the needle the coats of the bleeding artery on the cardiac side of the bleeding point," he has arrested hemorrhage without leaving, after the second or third day, any foreign substance in the wound. This method has been fully tried since its suggestion by its distinguished inventor, but has not yet supplanted the use of the ligature or proved widely acceptable to surgeons.

**Styptics** or **Hæmostatics.**—Among the older surgeons, much confidence was placed in the employment of styptics for arresting hemorrhage; but, at present, in serious hemorrhages surgeons seldom resort to them, except in cases where the ligature cannot be applied, as in oozing from a general surface, or in bleeding from the cancellated structure of bone.

In such cases the articles occasionally employed as styptics are the nitrate of silver, sulphate of copper, alum, tannic acid, tinctura ferri chloridi, and matico, either in leaf or tincture, nearly all of which act by constricting the vessel. Hemorrhage may also be arrested by the application of either fine sponge or dry lint, so as to favor the formation of a clot at the end of the vessel. This, when combined with pressure, occasionally answers a good purpose.

The perchloride of iron has lately been recommended as a hæmostatic. As a local styptic, three to five parts of the iron to 100 parts of distilled

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* Dorsey's Surgery, vol. i. p. 53, Philadelphia, 1823.
† Archives Générales, tome xx. p. 606.
‡ New York Medico-Chirurgical Bulletin, vol. ii. p. 212.

water poured on lint, and applied with pressure to the seat of hemorrhage, will often prove useful. Or take what deliquesces of the salt, as exposed in a bottle, and apply with a glass, brush, or rod to the bleeding surface.

Caution in the employment of this salt is necessary, as it is quite *caustic;* and its use, as an injection into the blood-vessels for the cure of aneurism, etc., should be avoided.

**Monsel's Salt.** — *Persulphate of Iron.* — M. Monsel, of Bordeaux, has recommended the persulphate of iron as a hæmostatic. The formula of this new salt is $5SO_3, 2FeO_3$. Its action on the blood is somewhat peculiar. It forms with it a voluminous clot, *absolutely insoluble*, which continues to enlarge for several hours after its application, and becomes quite hard and firm. When applied to a wound no pain results from its application. It acts by producing instantaneous coagulation of the blood, and will be found invaluable in hemorrhage from surfaces where it is impossible to ligate the vessels. In solution it is readily applied, as it is very deliquescent, and dissolves speedily in water—hence is often employed with satisfaction.

**Cauteries.**—The heated iron, or the actual cautery, though seldom resorted to, may be demanded in operations upon the bones of the face, or in other positions where the bleeding point cannot be tied. In order to adapt the cautery to these surfaces a great variety of shapes has been given to it, but those represented in Plate III. Figs. 3, 4, are all that are generally necessary. When a cautery is to be employed, it may be heated either to a red heat by fire, or kept plunged in boiling water. White heat will form an eschar which, on separating, is likely to bring on secondary hemorrhage; but the red heat will only induce contraction of the vessels and tend to develop adhesive inflammation.

The **Galvanic Cautery** obtained from the galvanic current derived from "six plates," has lately been recommended as a substitute for the actual cautery.

The advantages claimed for it are, that it is less alarming to the patient and friends, and "that the amount of heat can be exactly regulated, a red or white heat being generated, and kept up at will."

"Nélaton has recently used the electric cautery several times at his cliniques, and expresses himself very much pleased with it."[*]

Ellis,[†] of England, has invented a cautery for the neck of the uterus—which is instantly heated by being attached to a large Grove's battery. The necessity for the presence of a large battery must limit its general utility. At the Women's Hospital, New York City, under the charge of Marion Sims, such a battery is kept ready for use; and the cautery reported as highly serviceable, being prompt, almost harmless, and easily limited in its action and intensity.

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[*] Letter from Paris, by Geo. Suckley, M.D. New York Journal of Medicine, vol. iv. 3d series, p. 341, 1858.

[†] For further details, consult Electric Physiology, by Garratt, Boston, 1860.

## SECTION IV.

### AFTER-TREATMENT OF WOUNDS.

After accomplishing the object of his operation, and arresting the hemorrhage, the subsequent duties of the surgeon may be described as the closing and dressing of the wound and the general treatment demanded in regulating the healing process.

### ₰ 1.—Closing of Wounds after Operations.

The decision of the question of union by the first or second intention, having been in a great measure settled in the United States, by the almost universal practice of healing or attempting to heal every incision by the process of adhesion, the first dressing should generally be made with this object, an effort to close a part by granulation being an exception to the rule.

In attempting union by the first intention, the removal of all foreign matter is of great consequence, and may be effected either by squeezing a stream of water from a sponge upon the surface to be united, or by the direct application of the sponge itself. When the sponge employed in this or other cases is to be applied directly to the surface of a wound, it is requisite that it should be as soft and free from sand as possible, and the selection of a proper article is, therefore, a measure of some importance.

Good sponge for surgical purposes should be of moderate size, conical shape, fine texture, open cells, and sufficiently elastic to expand readily in the hand after water has been expressed from it. The whiteness is a matter of little moment, unless the bleaching process has been carried so far as to destroy its texture, when the value of the sponge will be much impaired. As usually found in the shops, all sponge contains more or less of sand, coral, etc., the presence of which would prove highly detrimental to a tender surface, and should, therefore, be carefully removed by the surgeon or his assistants some days before the sponge is to be employed. The best method of accomplishing this, and preparing sponge for surgical purposes, as tested by experience, is the following: Select a piece of sponge of the proper size, and pound it well while it is dry, so as to crush all the coral that may adhere to it. Then wash it thoroughly, pour off the water, place it in a porcelain vessel containing one part of muriatic acid to fourteen of water; let it soak two or more hours, or till all the sand is softened; then wash it in a solution of carbonate of soda—one ounce to the quart of water—and subsequently let it soak for an hour in running water, when it will be ready for use.

To close a wound after an operation, recourse may be had either to strips of adhesive plaster, about half an inch wide, and of a length sufficient to obtain a good surface for adhesion; to the application of collodion; to sutures, or simply to bandages as before described;* but in all cases of extensive wounds, before closing the skin by any of these means, it will be found useful to introduce a morsel of lint or linen between its edges, as suggested by Dr. Physick, in order to prevent union of the surface before the deeper parts have adhered, as this would tend to create an abscess.

**Sutures.**—Sutures or stitches are employed to unite such parts as, from their flaccid or movable condition, cannot be accurately held together

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* Page 97, et supra.

by other means.    For the formation of the suture various needles are re-
commended, see Plate IV. Figs. 8, 9, any of which may be selected, according
to the taste of the surgeon.    The only matter of consequence in their selec-
tion is, to see that they have good points, keen sides, and sufficient temper
to prevent their yielding to the force necessary for their introduction.    Com-
mon saddlers' silk or linen thread is the article generally employed for the
formation of the suture at the present day, though caoutchouc threads have
been deemed preferable by Nunneley, of England, and leaden strands,
advised in one form of the suture, (perineal,) by Mettauer, of Virginia.
Platinum sutures have also been praised by Morgan, of England, and silver
sutures by Marion Sims, of New York.    The latter are formed by fine *silver*
thread instead of silk.    They have the recommendation of causing but little
irritation, and may remain weeks without inducing ulceration.    Although
the suggestion of metallic sutures is not original, Sims is justly entitled to
the credit of reviving their use and rendering their application in most cases
one of the marked surgical improvements of this century.

    The sutures generally employed, as made with lead, silver, or silk thread,
are the Interrupted, the Twisted or Hare-lip, and, occasionally, the Quilled.
The Continued suture, and others recommended by the older surgeons, are
now seldom resorted to.

    The **Interrupted Suture** is formed of a series of separate stitches, and
will be found of service whenever it is desirable to approximate large flaps,
or those which present angles, as after crucial incisions and others of a
similar character.

    In making this with the metallic thread a special needle is necessary,
and is now prepared by the cutlers.    When ready, the operator should
seize the side of the wound nearest to him, or its most depending portion,
with the thumb and forefinger of his left hand, so that the latter will be on
the inner side of the skin, and, introducing the needle, with its convexity
downward and its point directed upward, pass it from without inward
through this flap, or side of the wound, and from within outward through
the other part, seizing the latter portion with the thumb below and the
finger above the surface of the skin.    Then, after the two sides are approxi-
mated by the fingers of an assistant, tie the ligature, if of thread or other
soft substance, by a double knot, or if of metallic thread, twist the ends by
forceps, so as to place the knot on *either side of the line of union;* then
cut off both ends of the ligature, close to the wound, Plate III. Fig. 12.
When the knots of sutures are permitted to press directly upon the line of
the wound, they are liable to induce marked irritation and to result in sup-
puration; while, if tied as directed, near either the point of exit or entrance
of the needle, they may sometimes be removed without a sign of inflammation.

    In making the points of a suture, the operator should remember not to
pass the needle deeper than the integuments, if possible; to include enough
tissue to sustain any strain that it may have to encounter; to avoid pricking
nerves or tendons, and to place the first stitch in the middle of a longitudi-
nal wound, the remainder being closed by as many points as may be requisite,
intervals being left between each.    In angular wounds, the first point of the
suture should be made at that part where all the free ends of the flap will
come together, and subsequently elsewhere, according to circumstances.
The interrupted suture, as well as all others, should be aided by the applica-
tion of adhesive strips or uniting bandages, when there is any traction neces-
sary in closing the wound, in order to diminish the strain upon the thread,
and its tendency to create ulceration.    In about three days, the stitches, if
of silk, should be removed by seizing the knot with the dissecting forceps,
elevating it slightly from the integuments, cutting the ligature beyond it,

and then drawing the thread carefully out; but in large, deep wounds, or in parts of a loose and movable character, the union of the parts should be maintained for several days subsequent to the removal of the thread by the continued use of adhesive strips. If silk or thread sutures are allowed to remain in a part longer than four days, except where they are passed so deeply as to include a large amount of tissue—as in the perineum—they will generally tend to prevent rather than favor union by adhesion, as they are apt to lead to suppuration or ulceration. The metallic suture creates but little irritation, even when left in situ for weeks. In removing the latter, cut it near the skin, and, carefully supporting the part with the point of one pair of forceps, withdraw the metallic thread with the other. Owing to the flexibility of the lead thread it offers less resistance in the removal of the suture than the fine silver wire, and is on this account generally preferable.

The **Twisted or Hare-lip Suture** is especially applicable to operations in which there has been considerable loss of integument, and where the strain upon the simple thread would probably cause it to tear out of the tissue, or to cases where the parts are very movable, as in the lips, cheeks, etc. In its application, a straight pin or needle should be held between the thumb and right forefinger, and, commencing at the lowest or free edge of the wound, be passed as deeply through the tissue as is consistent with safety, on the right side from without in, and on the left from within outward, the entrance and exit of the pin being favored by sustaining the parts with the thumb or forefinger of the left hand. Then, while the wound is well approximated by pressure from the fingers of an assistant, let the operator surround the pin with a thread, and, twisting it around the pin in the shape of the figure 8, tie the ends together over the line of the wound. After introducing as many other pins as may be necessary, their points should be removed, Plate IV. Fig. 10, or the surrounding parts protected from injury, either by a strip of plaster or by a pellet of wax on each end of the pin, and then the whole strengthened, if necessary, by adhesive strips.

Various opinions are entertained by operators as to the best material for the pins employed in this suture. Silver pins with movable steel points were at one time much used, and deemed especially suited to this mode of union; but large, well-silvered pins, or the straight steel needle advised by Heister, or pieces of wire sharpened at the point, as recommended by Dorsey, of Philadelphia, or the insect-pins proposed by Dieffenbach, can be more readily obtained, answer quite as well, and, in my opinion, better than those with movable points. Where the solid pins are resorted to, their points should be cut off with the scissors or bone-nippers, Plate III. Fig. 9, in order to protect the soft tissues.

The **Quilled Suture** is at present seldom employed, being limited to those cases where it is desirable to unite very thick tissues, as in operations, lacerations, etc. of the perineum. In making this suture, several needles should be threaded by passing both ends of the thread through the eye of the needle, so as to form a loop on the middle of the ligature. Then, while the parts are held as directed in the interrupted suture, let the operator pass the first needle through the left side of the part, from without inward, as deeply as may be necessary, commencing at the middle of the wound, and bringing it out on the right side from within outward. On removing this needle, let him next apply a small piece of bougie, quill, or soft wood on the left side of the wound, passing it through the loop; then, placing a similar piece between the free ends of the ligature on the right side, tie the ends of the thread loosely upon the quill, and after placing two or more stitches at equal distances from the centre, draw them into firm knots upon the quills, when the parts will be thoroughly closed by the pressure thus made upon them, Plate III. Fig. 11.

Such modifications of these sutures as may be required in special operations will be referred to under the appropriate head, and especially in the account of the Plastic Operations.

A peculiar mode of closing wounds by the application of a little serrated spring, termed by Vidal "Serres-fines," has been, within a few years, brought into notice by the French surgeons. The spring is sufficiently strong to hold the edges of a wound together, but the teeth, at the point of pressure, are apt to induce quite as much ulceration as that consequent on the use of the ordinary suture. They have no advantages over the metallic suture.

### § 2.—After-treatment to favor Union.

In the selection of such means as are requisite to facilitate the efforts of nature in healing a wound lies the great skill of the operator. Unless a surgeon is well grounded in the principles of surgery, or unless he unites in himself the knowledge requisite for a good physician, he may now mar the whole proceeding—all his mechanical dexterity or anatomical knowledge proving of little avail, if he is deficient in a knowledge of the great principles of inflammation. Now it is that judgment may be shown even in apparently neglecting the case, or in "masterly inactivity," too much anxiety and officiousness preventing the success of an operation almost as certainly as want of skill. The constitutional treatment at this period is, therefore, often essential to success; the efforts of nature may require to be restrained or stimulated; loss of blood, or purging, or a full or a low diet, after a capital operation, may be the means of saving or destroying the patient; and nothing but a knowledge of the treatment of inflammation, together with the practical tact that experience alone can furnish will enable an operator to conduct himself correctly in this most important part of his duty.

In this portion of the dressing, or that which has for its object the protection of the part from external agents, the means employed will usually consist in the application of spread cerate, or of lint wet with cold water, or of compresses and bandages, as already described in Chapter I.

I cannot, however, omit calling attention at this time to the great superiority of the water-dressing, as described under the head of Irrigation, over the old plan of spread cerate, compresses, etc.

As connected with these dressings, the operator should bear in mind the occurrence of secondary hemorrhage, the changes requisite in the articles employed as dressing, as well as the varied constitutional treatment rendered necessary by a change of action. Whenever, in any dressings, he desires to remove ligatures, let him seize the end of the thread between his thumb and forefinger, and make very slight traction upon it. If the ulceration of the vessel is completed, the ligature will readily separate by the least force; but if it is not, it should be left to nature. Occasionally, however, it happens that the ligature will remain attached to a vessel an unusual length of time, extending sometimes to fifty or seventy days, either in consequence of the employment of too large or too flat a thread, or from adhesions forming around its course, or from too much of the surrounding tissue having been included in the knot, with the vessel. Under these or other circumstances, when the operator is fully satisfied that time is being lost, he may resort to the expedient suggested by Physick, and twist the ligature slightly from day to day, or pass it over a compress placed at a short distance from the wound, and then, fastening the free end to a sound part of the limb by a portion of adhesive plaster, favor ulceration by the gentle strain thus exercised upon the ligature. If the tension thus exercised is moderate, it will

enable the knot to separate from the artery by hastening ulceration ; but if the traction is sudden or violent, it will be liable to induce hemorrhage ; judgment as to its employment is, therefore, necessary.    In fastening the free end of the ligature, the position of the part to which it is attached and its motions should be noted ; thus if a ligature coming from the thigh should be thoughtlessly made fast to the leg while flexed, the patient, in extending the limb, would be likely to tear the thread off the vessel ; so also in the arm and forearm.    The point to which the ligature from an artery in either extremity is attached should always be above the first joint.

## AMERICAN PAPERS ON THE PRECEDING SUBJECTS, EXHIBITING THEIR TITLE AND WHERE PUBLISHED.

Experiments on the Coagulation of Blood when out of the Body, (showing that the air is a strong coagulant of blood, and that it is not owing to cold,) by Thomas Hewson, M.D.    Philadelphia.—*Eclectic Repertory*, vol. i. p. 230.    1811.

On the Employment of Animal Ligatures, by Philip Syng Physick, M.D.  Philadelphia.—*Eclectic Repertory*, vol. vi. p 389.    1816.

Observations on Traumatic Hemorrhage, illustrated by Experiments on Living Animals, by Horace G. Jameson, M.D. Baltimore.—*American Med. Recorder*, vol. xi. p 3.    1827.

On the Use of the Bandage (to arrest hemorrhage and supersede the use of the knife and saw) in Gunshot Wounds, Fractures, etc., by Benjamin Winslow Dudley, M.D.    Lexington.—*Transylvania Journ. of Medicine*, vol. i. p 501. 1828.

Utility of the Bandage in Wounds of the Arteries, by N. Gaither, M.D.    Kentucky.—*Transylvania Journ. of Medicine*, vol. ii. p. 143.    1829.

Experiments on the Use of Metallic Ligatures as applied to Arteries, by Henry S. Levert, M.D.    Mobile, Ala.—*Am. Journ. Med. Sciences*, vol. iv. p. 17.    1829.

Torsion of Arteries, (practiced in December, 1826, in presence of Surgeons Rogers and Ford, British army ; three years before Amussat,) by George Bushe, M.D. New York.—*N. Y. Medico-Chirurgical Bulletin*, vol. ii. p. 212.    1832.

Report of Five Cases of Wounds of Arteries, treated by Compression, by T. S. Kirkbride, M.D.    Philadelphia.—*Am. Journ. Med. Sciences*, vol. xxiii. p. 324.    1839.

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On Collodion, or new Liquid Adhesive Plaster, by John P. Maynard. Boston.—*Am. Journ. Med. Sciences*, vol. xv. N. S. p. 577.    1848.

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On Cold Water as a Surgical Dressing, by J. C. Warren, M.D.    Boston —*Address of Dr. Warren before Am. Med. Association at Cincinnati.*    1850.

Collodion, Solution of Gutta Percha in Chloroform, Solution of Shellac in Alcohol, by L. A. Dugas, M.D.    Georgia.— *Southern Med. and Surgical Journal*, vol. viii. N. S. p. 664.    1852.

Use of Liquid Caoutchouc, by J. B. D. Stillman, M.D.    New York.—*N. Y. Journal of Medicine*, vol. xv. N. S. p. 254.  1855.

Localization of Baths, and Application of Heat and Cold to different parts of the Body, by Charles Mayor, M.D.    New York.—*N. Y. Journal of Medicine*, vol. ii. 3d S. p. 182.    1857.

Persulphate of Iron as a Hæmostatic, by H. H. Toland, M.D.    San Francisco, Cal. —*Am. Journ. Med. Science*, vol. xxxvi. N. S. p. 579.    1858.

Report of Cases in which Metallic Sutures were employed, by H. Lenox Hodge, M.D.  Philadelphia.—*Am. Journ. Med. Science*, vol. xxxviii. N. S. p. 61.  1859.

### ON ETHERIZATION.

Inhalation of Ethereal Vapor, for the prevention of Pain in Surgical Operations, (being the first cases in which it was used,) by John C. Warren, M.D.    Boston.—*Boston Med. and Surg. Journ.*, vol. xxxv. p. 375.    1846.

Also *Am. Journ. Med. Sciences*, vol. xiii. N. S. p. 260.    1847.

# PART II.

## GENERAL SURGICAL DISORDERS.

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### CHAPTER I.

#### INFLAMMATION.

INFLAMMATION is the term long employed to indicate that change in the normal nutritive or preservative action of a part that is characterized by unusual *redness* and *heat*, as well as by *pain, swelling*, and *perverted secretion*.

The term inflammation, though purely metaphorical, has been so widely applied to designate the disordered condition above alluded to, that it is useless to modify it. By the Romans the word was adopted as expressive of the heat that usually attended this condition—*in*, within, and *flamma*, a flame; while the Greeks designated the same state by the word *phlogosis*, thus indicating the burning character of the pain that accompanied it; hence remedies especially calculated to prevent or diminish inflammatory action were termed *antiphlogistics*.

Whenever inflammation is developed it should be carefully watched by the surgeon, lest it result in evil; not that its action is always to be checked or interfered with—as it is sometimes essential to the success of certain surgical means of relieving disease—but simply that it may be kept within proper bounds.

In the study of the phenomena of inflammation, surgical writers have exhibited considerable minuteness of detail, and, in order to show the tendency of certain of its forms, to present certain characteristics, have created what they term the "Varieties of Inflammation."

### SECTION I.

#### VARIETIES OF INFLAMMATION.

Under the head of varieties of inflammation are usually placed such forms as are spoken of as Healthy and Unhealthy, Circumscribed and Diffused, Acute and Chronic. It must, however, be apparent that the terms Healthy

and Unhealthy owe their origin rather to convenience than to correctness of nomenclature, as the very definition of inflammation shows that the word is employed to designate a departure from healthy action.

By **Healthy** inflammation, surgeons, however, understand that in which the tendency of the inflammatory action is to a reparative result or to healthy action. By the term **Unhealthy** inflammation, we express one whose tendency is destructive, or which results in an unnatural or unhealthy condition of the part that has been inflamed.

The words **Circumscribed** and **Diffused** are indicative only of the extent of the disorder; while **Acute** and **Chronic** have reference solely to its duration—**Acute** meaning one that is recent and active, and **Chronic**, one of longer continuance.

An **Acute** inflammation is characterized by active vascular excitement, by a bright-red color of the part, by heat, and by pain of a troublesome kind. It is sudden in its attack, violent in its character, and rapid in its progress. Acute inflammation is sometimes also designated as **Active** inflammation.

**Chronic** inflammation is one of less violent and tardy action, and hence is sometimes called **Passive** inflammation. All its symptoms are less prominent than those seen in the acute variety; thus the color is less bright, the heat and pain less marked, and nature is longer in restoring the inflamed parts to their former condition.

## SECTION II.

### SYMPTOMS OF INFLAMMATION.

The **Symptoms** of inflammation or the signs by which its presence is made known, are noted both in the action of the part as well as in that of the system at large; hence surgeons speak of the local and general symptoms of inflammation.

### § 1.—Of the Local Symptoms of Inflammation.

The local symptoms of inflammation may be classified under—1. Changes of color. 2. Changes of temperature. 3. Changes of sensation. 4. Modifications of the size and consistence of the inflamed part; and are usually described under the heads of Redness, Heat, Pain, and Swelling, or the "rubor, calor, dolor, and tumor" of Celsus. Besides which more or less functional disturbance is generally noticeable.

### I.—CHANGE OF COLOR, OR REDNESS.

As every one is familiar with the ordinary or natural character of the external portions of the body, the change of color consequent on inflammatory action has long been regarded as one of the most prominent signs of its presence. Redness, in order to be characteristic of inflammation, must, however, be of a tint which is *above* the natural standard of color. In acute inflammation it is of a bright scarlet, but in chronic it is of a more purplish hue. It is generally most marked at one spot—the focus—and decreases or shades off to the healthy tint as it departs from this centre. Sometimes it ends abruptly, and by a well-defined margin; but in other instances, as in

erysipelatous inflammation, it is irregular, or even fringed and indented on its edge. The pressure of the point of the finger often destroys the red color, and renders the point pressed on momentarily paler than is natural; but the instant the pressure is removed, the redness is rapidly restored, thus furnishing a good test of the activity of the circulation in the inflamed part.

The redness of inflammation is usually due either to the flow of an unusual quantity of blood into the part, or to the admission of the red corpuscles into vessels which, to the unaided eye, do not carry them, or in which they will not circulate without becoming obstructed; thus, if the conjunctiva, or any other tissue which is usually colorless, becomes inflamed, its vessels soon are made apparent, though previously unseen.

Fig. 131.

Fig. 132.



A VIEW OF THE RABBIT'S EARS, AS SEEN IN HUNTER'S EXPERIMENT.—The right or inflamed ear, A, shows the character of the enlarged vessels; many being apparent in it which are not visible in the left ear, B, or that which is uninflamed.
The vessels in the inflamed ear are nearly four times as large as those in the healthy ear. (After Paget.)

DIAGRAM SHOWING THE STATE OF THE CORPUSCLES IN THE VESSELS BOTH WHILE CIRCULATING AND ALSO AS ARRESTED DURING THE CONGESTION OF INFLAMMATION.—a, a. Colorless or lymph corpuscles on the sides of the vessel. b, b. Blood corpuscles circulating in the centre of the vessel. c, c. The stagnant blood, or arrested red corpuscles, which is one cause of the redness of inflammation. d, d. Corpuscles oscillating and detached from the stagnant mass before ceasing to move. e, e. Intervascular spaces, into which serum, colored by hematin, sometimes escapes, and is another cause of redness. (After Williams.)

But, though the redness of an inflamed part had been so often noticed, its cause was long one of the disputed points of pathology; some observers insisting that it was due to the formation of new blood-vessels, while others argued that there was only a dilatation of such as previously existed. To settle this question, Mr. John Hunter experimented as follows: By freezing the ear of a rabbit, and then thawing it, he developed considerable inflammation in one ear; then killing the animal, and injecting both the inflamed and healthy ear, he noted precisely the same vessels ramifying through both; but, in the inflamed ear, the arteries were much more distinct and enlarged than they were in the healthy ear.* A repetition of his experiment by

* Hunter on Inflammation, p. 309. Philadelphia edition, 1841.

myself has furnished a similar arrangement to that illustrated in Fig. 131.

The enlargement of the vessels of an inflamed part affects equally its arteries, veins, and capillaries, and usually extends to some distance beyond the focus of the inflammation. The amount of the enlargement of the vessels in an inflamed part is not, however, always the same, as it extends sometimes to two or three times the ordinary diameter of the vessels affected. From the observations of modern observers, as Bennett and Paget, it also seems that, in addition to the enlargement of the blood-vessels under these circumstances, there is a change in their shape, and that they are thrown into curves which are more or less wavy and tortuous; while Kölliker and Hasse state that the vessels sometimes present gradual fusiform dilatations of their whole circumference similar to those seen in aneurisms.*

The microscopic examinations of Wharton Jones, Alison, Williams, and others have also shown that the red color of an inflamed part is due not only to a change in the calibre and arrangement of the vessels, but also to a modification of the position of the elements of the blood, and especially the condition of its red and white corpuscles. In health, the red corpuscles of a transparent structure—as the web of a frog's foot—can be seen circulating with rapidity in the centre of the vessel, while on each side is contained the white corpuscles and liquor sanguinis, Fig. 132, which circulate more slowly; but as soon as inflammation is developed, a change, it is said, can be noted; the red corpuscles beginning to retrograde, then to oscillate, and at last to cease to move, the blood becoming stagnant, as it were, in the vessel, the corpuscles, by their permanency, adding to the color of the tissue which is inflamed. Another but minor cause of the increased redness of the inflamed part is sometimes seen, as stated by Paget,† in the oozing of the coloring matter (hematin) of the blood corpuscles, both into the interspaces which exist between the corpuscles in the vessel, or into the liquor sanguinis, as well as into the areolar structure, when it escapes from the vessel into the adjacent tissues.

From these observations it is, therefore, apparent that the red globules of the blood are the chief agents in producing the color of inflammation.

The red color of a part, when above the natural tint, may generally be regarded as evidence of inflammation, especially if it is accompanied by other symptoms, as heat and swelling; but redness alone is not a positive sign of inflammatory action. Blushing creates it, and muscular effort, as in violent exercise, produces congestion; yet neither would justify the surgeon in thinking that the part was inflamed, simply because the redness was above the natural standard.

## II.—CHANGE OF TEMPERATURE OR HEAT.

The heat or increased temperature of an inflamed part is another prominent symptom, so much so as to have given its name to the entire disorder, as before stated. Though marked, the heat of an inflamed structure is not so much above the natural standard as the sensations of either the patient or the surgeon might tempt him to suppose, it being seldom above that of the centre of the circulation or the heart of the one who suffers from it. To prove this, Hunter performed various experiments; thus he made an incision two inches deep into the gluteal muscle of an ass, so as to inflame it, and also developed inflammation in the rectum and vagina of this animal

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* Paget's Lectures.   Philadelphia edition, p. 196.          † Ibid.

and in the thorax of the dog. On testing these inflamed parts with a thermometer, he, however, found that the instrument indicated only a rise of temperature of about 1 degree as compared with the natural heat of deep-seated parts, and that then it did not exceed that of the blood in the heart of these animals. By blistering the chest of a patient he also found that the difference between the heat of the inflamed and of the surrounding parts was not more than 1 or 2 degrees; but, on applying a blister to the extremities which, in consequence of their distance from the heart, are naturally colder, he found that the variation of the temperature between the healthy and inflamed parts was between 5 and 7 degrees. He also noticed the same fact in operating for the radical cure of hydrocele upon a patient in St. George's Hospital. On opening the tunica vaginalis, the thermometer rose only to 92 degrees; but the next day, when inflammation was developed, it was exactly $98\frac{3}{4}$ degrees. But though this showed an increase of $6\frac{3}{4}$ degrees, the heat was not greater than that at the source of the circulation in the same man.

These experiments are, therefore, universally regarded as proving that the actual rise of temperature in an inflammation of *deep-seated* parts, or those near the heart, is slight—1 degree—although in *distant* or *superficial* parts, or in the extremities, it is $6\frac{3}{4}$ degrees, and that in all instances it was not above the heat of the blood in the heart; thus showing the deceptive character of the evidence furnished by the sensations of the patient.

The cause of the heat in an inflamed part has been variously explained. Hunter attributed it to the increased flow of arterial blood raising the temperature to that of the blood at the heart. Travers ascribed much to the action of the nerves upon the circulation; while Liebig regards it as resulting from the greater number of the red corpuscles introduced into the vessels; these corpuscles being, as he supposes, oxygen carriers, and the production of heat by them the result of a chemical action in the tissues.

Unusual heat, like redness, may and does exist without being indicative of the presence of inflammation. Unless, then, the heat is preternatural, of some duration, and conjoined with some of the other symptoms, it cannot be regarded as positive evidence of the presence of inflammation.

### III.—MODIFICATION OF SENSIBILITY OR PAIN.

The pain of inflammation is a prominent symptom, though it is not always present in a marked degree. It varies in its character in the inflammations of different tissues, and sometimes also in different attacks of inflammations in the same tissue, being described as burning, tingling, itching, throbbing, lancinating or shooting, sharp, dull, and obtuse—terms which require no explanation. Inflammation of the *skin* is generally accompanied by a burning or tingling pain; in the *areolar tissue* it is throbbing or pulsatile; in the *serous membranes*, sharp and lancinating; while in *glands*, as the parotid, kidney, or testicle, and in the mammary gland of the female, it is dull and heavy. The sensibility of all parts is not, however, invariably augmented when they become inflamed, but is, on the contrary, diminished; as in the inflammations of the mucous membranes of the mouth, nostril, and ear, where sensibility, as respects the function of smelling, taste, and hearing, is diminished, though the part may be painful when touched.

The development of pain by inflammatory action is apparently due to the functional disorder of the nerves of the part, or sometimes to the distention of the tissues produced by the congestion in its blood-vessels, or the presence and confinement of the liquid products of inflammation.

As indicative of the presence of inflammation, the existence of pain

should always be cautiously examined by the surgeon, as neuralgia or sim-
ple functional disorder of a nerve often causes intense pain without there
being any inflammatory action in the part, and the diagnosis of the latter
becomes, therefore, a matter of importance.

Generally, *neuralgic* may be distinguished from *inflammatory* pain by
the fact that pressure relieves the former but augments the latter, while the
gravitation of the blood to an inflamed part augments its sensibility, and
yet has little effect on the neuralgic condition.    Lastly, neuralgic pain may
continue for many days without developing any of the results of inflam-
matory action, especially suppuration, which sooner or later becomes appar-
ent when inflammatory action has continued for a short period.

Though so frequently present, pain is not essential to inflammation ;
numerous instances being recorded where even severe inflammation has ex-
isted without its presence having been shown by pain.

The location of the pain is also no evidence of the locality of the inflam-
mation ; thus inflammation in the hip-joint is often first shown by pain
which is referred to the inner side of the knee, and irritation of the neck
of the bladder causes pain at the end of the penis; while in inflammation of
the liver the pain is often referred to the right or left shoulder blade, in
accordance with the lobe affected.

## IV.—MODIFICATIONS OF SIZE AND CONSISTENCE, OR SWELLING.

Like all the so-called symptoms of inflammation, swelling is not constantly
present ; nor is its presence by any means pathognomonic.    Thus, on the
one hand—as in certain cases of conjunctivitis and other inflammations of
free surfaces—a considerable degree of inflammatory action may be present
without any perceptible tumefaction, so, on the other, new growths may
give rise to marked swelling without there being the slightest reason to sus-
pect the presence of inflammation.    Swelling then becomes important in the
diagnosis of inflammation, only when taken in connection with other symp-
toms.    The enlarged bulk of an inflamed part is generally, though not in-
variably, combined with some change in the consistence of the tissues affected,
these being more or less indurated or unnaturally soft.

The degree of inflammatory swelling, taken in connection with the consist-
ence of the part affected, often affords much aid in judging of the nature of
the disorder in any particular case.    Its characters vary much ; thus, the
swelling may be irregular and extensive, as in erysipelas, or circumscribed,
as in acute abscesses.    The part may be soft, pitting on pressure, as in
œdema, or hard and unyielding, as in subcutaneous phlegmons before sup-
puration, or more or less marked fluctuation may be present, as in collections
of pus.    An inflammation may also present several of these characters simul-
taneously at different portions; thus, the inflamed part may fluctuate in the
centre, where pus has begun to accumulate, and this central soft point may
be surrounded by an induration of greater or less extent, beyond which
there may exist considerable inflammatory œdema.    Inflammatory tumefac-
tion is due, partly to the accumulation of blood in the vessels of the part,
but chiefly to the additional amount drawn by cell action into the cells and
intercellular substance, and not, according to Virchow and the more recent
physiologists, to any exudations into the tissues.    The amount of the swell-
ing varies somewhat in accordance with the tissue affected, being greatest in
those of a loose texture, like the areolar, and least in those which are firm
and dense, as the glands and fibrous tissues.

## V.—MODIFICATION OF NUTRITION, OR FUNCTIONAL DISTURBANCE.

Functional disturbance is one of the most invariable of the symptoms of inflammation, and, indeed, inflammation seldom, if ever, occurs without it. Nevertheless, like the other symptoms, its presence is by no means pathognomonic, as considerable functional disturbance may result from causes totally diverse. The effect of inflammation upon the function of the organ or tissue affected varies with the stage of the inflammation and with its grade. The first effect of a commencing inflammation, or of the state of irritation that precedes its more marked stage, is not unfrequently an *increase* in the functions of the organ, and an augmentation of the nutritive processes. It is thus that increased cell action or secretion and hypertrophy sometimes result from moderate inflammatory action. When inflammation is fully established, however, the function of the part, and the normal nutritive processes, are generally entirely arrested, and though later in the course of the disorder the proper function may be re-established, or even increased, it is generally perverted; thus, for example, the secretions of an inflamed organ, which were suppressed at the height of the process, reappear at a later period, but are no longer normal, being mixed more or less with the different products resulting from the inflammatory action. Hence they present characters which vary in accordance with the latter. The effect of inflammation on the normal nutrition of a part will be discussed hereafter under the head of the Products of Inflammation.

## SECTION III.

### OF THE GENERAL SYMPTOMS OF INFLAMMATION, OR INFLAMMATORY FEVER.

The general symptoms of inflammation vary greatly in accordance with the stage, grade, and seat of the disorder. In some instances, a certain degree of inflammation may exist without any apparent constitutional disturbance; but acute inflammation, if of any extent, will very generally be accompanied by a group of phenomena which have collectively received the designation of Symptomatic, Sympathetic, Irritative, Traumatic, or Inflammatory Fever.

**Inflammatory Fever.**—As all parts of the body are closely connected by means of the nerves—or, to use an old expression, "sympathize with one another"—the establishment and continuance of inflammation by the injury of any part, sooner or later develops disordered action in the general functions of the body, the effects of the primary irritation being transmitted from the part injured to the brain. To this communication the brain replies through the spinal marrow and nerves, creating a state of general, though temporary, depression, until, by the inherent powers of life, it is overcome, and results in over-excitement or fever.

**Symptoms.**—Like other fevers, inflammatory fever begins with a stage of depression or chill, in which the skin is cold, and its papillæ prominent—"goose flesh," "cutis anserina,"—the heart's action is diminished, and the pulse is slow and feeble; the blood therefore leaves the surface of the body and accumulates in the internal organs, often inducing marked, though temporary, congestion. The muscles soon after this give evidence of deranged innervation, and as they contract imperfectly, irregular shiverings or tremblings occur, which the patient cannot control, thus creating "rigors" or shivering. Dis-

ordered innervation in the great nervous centres is also further manifested by aching pain in the head, back, and limbs, and by a sense of debility, which induces the patient to assume the recumbent position, thus developing the stage technically known as the "cold stage" or "*Chill*." This chill varies greatly in violence and duration, and passes ultimately, by a gradual transition, into the stage of reaction, or the "hot stage" or "*Fever*." In this there is a return of the powers of the system, and therefore we note increased force of the circulation, the heart beating more rapidly and forcibly, the pulse becoming fuller and quicker, counting from 80 to 130 per minute, and feeling more or less like a cord. The respiration also is more active, and as the secretions are usually more or less checked, the tongue becomes coated and dry, particularly on its sides and top; the skin is hot and dry, assuming, especially upon the face, a florid color, while most of the other tissues and organs also show that their secretions are suppressed and their nutritive processes deranged; hence we have torpor of the bowels, diminished and high-colored urine, etc.

The stage of fever, thus established, may last a variable period of time, as from a few hours to several days, and end in the "sweating stage," or that in which there is a return of all the secretions of the body. When inflammatory fever is prolonged, there is generally an aggravation of the symptoms toward evening, with a slight remission in the morning, the sweating stage being absent or but lightly marked.

**Diagnosis.**—Inflammatory fever, as presented in surgical cases, is not liable to be confounded with other affections; the history of the injury, and the development of the local disturbance, in connection with the constitutional disorder, generally sufficing to establish a correct diagnosis. In complicated cases, as in the supervention of injury on exposure to miasm, cold, etc., there may be difficulty in satisfactorily determining whether the febrile condition is due to the injury or not; but in the majority of instances of inflammatory fever which come under the notice of the surgeon, the local affection precedes, by some hours, the development of the febrile reaction.

**Prognosis.**—When inflammatory fever is about to terminate favorably, the pulse becomes slower, the skin more moist and cool, the tongue clean, and the secretions are generally re-established. The urine—which, with the other secretions, is now increased in quantity—not unfrequently lets fall a lateritious sediment of uric acid, or of the urates, and such a deposit is therefore generally considered a favorable symptom.

When this fever is about to terminate fatally, the pulse becomes more rapid and feebler, and toward the close, irregular and intermittent; the extremities become cold, and the countenance hippocratic.

The violence of the symptoms of inflammatory fever in surgical cases generally indicates the importance of the local action from which it originates, being more severe in inflammations due to wounds of internal organs, as of the lungs, etc., than to superficial inflammation.

The interval that supervenes between the cause and the appearance of febrile symptoms varies, being prompt in proportion to the vitality of the portion injured. The character of the pulse also differs somewhat in accordance with the tissue inflamed; thus, in inflammation of the skin, mucous tissue, or glands, as the testis, etc., it is full and strong, though easily compressed, while in peritonitis it is small and tense.

## SECTION IV.

### OF THE NATURE OF INFLAMMATION.

The innumerable theories which have been advanced in regard to the nature of inflammation renders it desirable rather to give a succinct statement of the chief facts gathered by investigators and a brief account of the most reliable modern views on this subject, than to discuss their relative merits.

As the disturbances noticeable in the *circulation* of the inflamed part are readily seen, and were well described at a comparatively early period, and as many pathologists, even at the present day, regard these disturbances as the *cause*, or at least as the starting-point of the phenomena of inflammation, they will be first alluded to, although the tendency of the more recent investigations is to diminish more and more the importance with which these changes have been regarded, and to refer to them as the results rather than as the causes of inflammation.

### § 1.—Of the Disturbance of the Circulation in the Inflamed Part.

In order to appreciate the changes noted in inflammation, the student must recall the normal manner of the circulation as observed by microscopists in transparent tissues, such as the web, tongue, and mesentery of the frog, the wing of the bat, the mesentery of certain young mammals, etc.   When these textures are properly exposed to microscopic study, it can be readily seen that red corpuscles circulate in the centre of the blood-vessel, while the white corpuscle and liquor sanguinis, quite free from red corpuscles, circulate more slowly along the sides.

The number of red corpuscles circulating in the centre of the stream is always marked, though it varies somewhat in accordance with the size of the vessel, attaining a minimum in certain of the smallest capillaries where they are sometimes so arranged as to pursue each other in single file.   The rapidity of movement in the central current is so great that it is often quite impossible to determine exactly the outline of each individual corpuscle. This, however, is not the case with the white corpuscles, which move slowly enough to enable their characters to be accurately observed.   From these facts the peripheral portion of the contents of any vessel has been named the **still** layer.

This still layer is chiefly concerned in normal nutrition.

Another element which must not be overlooked in the study of the disturbances of the circulation in inflammation, is the anatomy of the vascular wall itself.

Without going into the histology of the blood-vessels, it may be here stated that the arteries present three coats, one of which is elastic or contractile, though in the small arteries with which we are now chiefly concerned the yellow elastic tissue which exists so abundantly in the middle coat of the larger vessels is quite wanting.   Indeed this element, which is at its maximum in the great arteries, as the aorta, the iliacs, etc., diminishes greatly in arteries of medium size, and is not to be observed in arteries smaller than one line in diameter.*   Arteries of this size consist, like the larger vessels, of an internal, middle, and external coat.   The internal coat is com-

* See Kölliker's Mic. Anat., p. 679.   Philada. edit., 1854.

posed of an epithelium disposed upon an elastic basement membrane.  The middle coat is "purely muscular, without the slightest admixture of connective tissue and elastic elements,"[*] the muscular fibres being disposed circularly.    The external coat, like that of the larger vessels, is chiefly composed of white fibres, with a slight admixture of yellow elastic tissue.    Arteries of this size still possess nerves and vessels of their own.    As these arteries diminish in size, the nerves and vessels of the coats disappear, and these several coats also suffer a proportional diminution.    The elastic tissue of the external coat totally disappears in arteries smaller than $\frac{1}{10}$ of a line, and the coat itself gradually diminishes in thickness to a mere structureless membrane, and in vessels $\frac{1}{1600}$ of an inch in diameter it disappears.    The middle coat likewise diminishes with the size of the vessels to a single thin lamina, then the elements become scattered, and finally disappear altogether.    The vascular wall is thus ultimately reduced to its greatest simplicity, and consists, in the capillaries, merely of a homogeneous membrane, which, in the present state of our knowledge, must be looked upon as perfectly structureless,[†] in which are imbedded here and there scattered nuclei, the remains of the cells out of which the capillaries are developed.

After this brief statement of the components of the vessels and of the course of the circulation in normal nutrition, we may next note the changes created in inflammation.

If a small artery which presents the conditions described as normal be selected for observation, and stimulants be applied, whether in the form of heat, the touch of a needle point, or various stimulating solutions, the first effect to be observed is a contraction or diminution of the calibre of the vessel, attended by a *simultaneous retardation* of the blood stream, according to Paget,[‡] Wharton Jones,[§] and others; while according to Rokitansky,[‖] Lebert,[¶] and others, the contraction is accompanied by an *acceleration* of the blood stream.  This discrepancy, however, may perhaps be accounted for by the statement of Wharton Jones,[**] Paget,[††] and Carl Wedl,[‡‡] that retardation only accompanies the contraction of a vessel when it affects a considerable portion of its length, while if but a short portion of the vessel be contracted, the blood stream in it is accelerated.  Contraction of the vessel may be inappreciable or quite absent in the case of certain more potent stimuli, as indicated by Rokitansky and Paget.    In this case, the first appreciable phenomenon is dilatation, which else appears consecutively to a contraction of greater or less duration and degree.    Concerning the rapidity of the blood current in the state of dilatation, the same diversity of opinion exists as has been mentioned above in connection with contraction of the vessel, Paget, Wharton Jones, Carl Wedl, and others asserting that the dilatation is at first accompanied by acceleration of the blood stream, while Rokitansky, Lebert, etc. attribute to it a retardation of the current.    Wharton Jones accounts for this discrepancy as he did in the case of the contraction, by asserting that acceleration accompanies dilatation of a considerable length, while retardation occurs in dilatation of but a minute portion of a vessel.    After the circulation has continued in this condition for a variable period of time, its rapidity diminishes, without, however, any diminution in the size of the blood-vessels.    The cause of this loss of speed in the still dilated artery is to be found, according to Wharton Jones, in a stagnation existing in some

* See Kölliker, loc. cit.          † Ibid., p. 690.          ‡ Paget, p. 199.
§ See Guy's Hosp. Rep., New Series, vol. for 1850, p. 39.
‖ Path. Anat., vol. i. p. 99.          ¶ Physiol. Pathol., vol. i. p. 6.
** Opus cit.          †† Opus cit., p. 204.
‡‡ Rudiments of Path. Hist., p. 19—Sydenham translation.

of the capillaries supplied by the vessel. Be this correct or not, the retardation becomes more and more marked until it may terminate, particularly after the application of potent stimuli and in vessels of small size, in complete stagnation (stasis) of the current.

This condition begins in the capillaries, according to Wharton Jones, and extends from them to the artery. Complete stasis is preceded by the *oscillation* of the blood stream — a condition probably due to the resistance offered to the arterial current, by stasis in some distal vessels, the elasticity of the vascular wall causing a reverse flow after the distention produced by each pulsation of the heart. Simultaneously with these changes in the rapidity of the circulation, certain disturbances take place in its *manner*. Of these, the encroachment of the red corpuscles upon the still layer, and the consequent crowding of the vessel with these bodies, is the most universally admitted. The accumulation of *white corpuscles*, upon which much stress is laid by some writers, is stated by others, as Paget, Wharton Jones, and Bennett, to be neither a constant nor even a frequent occurrence in warm-blooded animals, and as far as man is concerned, it is stated by Paget* that the increased quantity of white blood corpuscles was not observed by him in a careful examination of the blood drawn from inflamed parts.

### ₂ 2.—Of the Changes in the Composition of the Blood.

Not only do decided disturbances occur in the **manner** of the circulation in an inflamed part, but changes also take place simultaneously in the blood itself. We have already remarked the crowding together of the red corpuscles in the vessels of the inflamed part, and other modifications no doubt occur in the blood of the involved vessels, though they have not been thoroughly demonstrated. When inflammation exists to any extent, however, marked changes in the composition of the whole of the blood of the body ensue, and it would not be unreasonable to infer that similar changes—with the exception, perhaps, of the elimination of the red globules—take place on a smaller scale in the vessels of the inflamed part. Of the changes referred to, the chief is the abnormal increase of fibrin observed in the blood of patients laboring under inflammation which is so marked as to create a yellow layer on the clot of blood drawn from the body, this layer being long familiarly known as the "buffy coat." When seen, it generally indicates a relative excess of fibrin, but is not limited to inflammation. The degree to which this fibrin is increased in inflammation varies in accordance with the extent and violence of the disorder, from five to ten parts to the thousand,† (2–3 parts being the normal quantity.) Simultaneously with the increase of fibrin a diminished quantity of albumen, of red corpuscles, of the chloride of sodium, and the soluble alkaline salts is observed,‡ with a marked augmentation of the quantity of cholesterin and other fats. In consequence of these changes, the specific gravity of the entire blood and of the serum is somewhat lessened.

How this change in the relative proportion of the constituents of the blood is produced by inflammatory action, it is impossible for us in the present state of our knowledge to explain in a satisfactory manner, nor can we show the precise relation between them and the inflammatory or symptomatic fever described previously. So far as the increase of fibrin is concerned, it is, however,

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* Opus cit., p. 206.
† See Becquerel et Rodier, "Traité de Chimie Pathologique," pp. 59, 60.
‡ Same authors, loc. cit.

readily accounted for by the doctrines of the cellular pathology advanced by Virchow, the latter believing that the fibrin of the so-called inflammatory exudations is of local origin, as will be subsequently explained, and, being reabsorbed into the circulation, produces an excess of fibrin in the blood, proportionate in degree to the extent of the local disordered cell action

### § 3.—Of the Structural Changes in the Inflamed Part.

It has long been known that inflamed tissues undergo certain structural alterations, and these, under the names of inflammatory softening, inflammatory induration, etc. etc., have been alluded to by the earliest writers. Considerable obscurity, however, has existed as to the precise nature of these alterations, and the question cannot even now be regarded as definitely settled. The latest account offered of these changes is that of Virchow.

According to this able pathologist, the first change which occurs in an inflamed part is an altered action in its component cells, in consequence of which they appropriate to themselves an unusual amount of nutritive material from the blood. Each individual cell being thus increased in size, the surrounding intercellular tissue is also augmented in quantity—the latter being dependent on cell action for its development, a very considerable tumefaction being thus created without the existence of any exudation properly so called.

At a subsequent period, the nuclei of the cells being subdivided, the cells themselves multiply by division, and from this source result all the form-elements of the so-called products of inflammation, such as the elements of plastic lymph on the one hand, and of pus on the other.

Simultaneously with these changes, a certain amount of fatty degeneration is apt to occur, as shown by the appearance in the elements of fatty granules of various sizes, formed at the expense, it is believed, of the nitrogenous substance of the elementary forms. The microscopic appearances of fatty degeneration, under these circumstances, are identical with what may be observed in fatty degenerations from other causes. (See ATROPHY.) All grades of degeneration may be present, from the appearance of a few fat granules in some of the elementary forms to a condition in which each normal structural element seems to be reduced to a mass of fat granules, which ultimately separate from each other and float free in any fluid that may be present.

These changes, which are well described by Paget,* have been studied by Virchow,† in inflamed muscles and bones; and by Goodsir and Redfern,‡ in the cartilages. The ultimate consequences of the degeneration here described may be the disappearance of much of the normal structure of the affected part, the degenerate tissue finally liquefying and undergoing absorption. When this effect is only partially produced, inflammatory softening is the prominent result. Whether atrophy, liquefaction, and ultimate absorption of the inflamed part may be produced in any other manner than the above, is not a settled point.§

The causes of the above changes are thus described by Paget :—

"1. They are due to the natural degeneration of the tissue. That degeneration which would be progressive in the healthy state, but which would

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* Op cit., p. 266.                                        † See Paget, loc. cit., p. 266.
‡ Abnormal Nutrition in Articular Cartilages.   Edinburgh, 1850, etc.
§ See Paget, p. 266.

then be unobserved, being constantly repaired, is still progressive in the inflamed state of the part, and is the more rapid because of the suspension or impairment of the proper conditions of nutrition.

" 2. They are due, also, to the penetration of the products of inflammation into the very substance of the affected tissue ; not merely into the interstices of its elementary structures, but into these structures themselves. These two methods of change are not essentially connected, but are generally in various proportions coincident and mutually influential."*

As in inflammation a sufficient disturbance of the nutritive conditions may exist to lead to degeneration of the affected textures, so also when a more complete disturbance or destruction of these conditions occurs, the *death* of the affected form-elements ensue, and ulceration or gangrene is the consequence, as will be shown in a subsequent section.

## SECTION V.

### OF THE PRODUCTS OF INFLAMMATION, OR THE METAMORPHOSES OF CELL ACTION DEVELOPED BY IT.

The disturbed state of the nutritive action of an inflamed part having, as just shown, the effect of determining a very considerable change in the action of the component cells of the affected tissue, the transudation from the blood-vessels of the more liquid parts of the blood might reasonably be anticipated, thus giving rise to a condition which has been described by systematic writers as the various exudations, deposits, or metamorphoses of inflammation. The first of these is usually designated as the effusion, deposit, or exudation of serum. As the term exudation has long been used to designate this condition, it is perhaps best not to change it, though metamorphosis expresses more correctly the action thus alluded to.

#### § 1.—Of Serum.

The liquid which, under inflammatory action, is made apparent, especially in areolar tissue, is very similar to the serum of the blood as drawn from the body after the clot containing the corpuscles and fibrin has been removed. The precise quantity of its several ingredients are, however, subject to considerable variation; thus the albumen contained in it is sometimes fully equal to the proportion normally in the blood, though it is often considerably less. The fatty matters, salts, and extractives also vary considerably—a large proportion of cholesterin being often remarked.

When serum is collected unmixed with blood, it is clear, transparent, or slightly opaline, of a straw-yellow, or sometimes an amber-yellow color, alkaline in its reaction and varying in its specific gravity from 1005 to 1030 or more.

The best examples of this serum are to be found in certain inflammations of serous membranes, in the fluid of some blisters, etc. When the exudation of serum occurs in the areolar tissue, it produces that variety of swelling which is termed œdema, (οιδεω, I swell,) and which, when the part is examined, is characterized by pitting upon pressure. A certain amount of œdema is often observable around a focus of severe inflammation, and indeed the substance under consideration probably precedes in every instance

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* Pa_et, p. 258.

the fibrinous exudations or deposits. It is the admixture of some portion
of this fibrin with the serum which sometimes creates a thickening and indu-
ration of tissue analogous to that which ensues upon the effusion of pure
lymph or fibrin.

The effusion of serum during the inflammatory process not unfrequently
proves beneficial to the patient, as it seems to diminish the amount of fluid
in the distended vessels, and thus apparently facilitates the onward flow of
the blood which had been arrested. It must, however, be admitted that the
temporary relief of throbbing, pain, etc., which patients experience on the
occurrence of swelling from this effusion, cannot be entirely explained on the
simple principle of relief to the mechanical distention, something being also
doubtless due to the coincidence of the effusion of serum with such a change
in the local inflammatory action as permits the restoration of secretion in
the tissues, or the natural action of the adjacent cells.

The quantity of the serum formed under inflammatory action varies greatly
—usually attaining a maximum in chronic inflammations of serous membranes
and in œdematous erysipelas. This is sometimes so great as to be a source
of danger or inconvenience, and to require surgical interference, as will be
detailed in other parts of the work.*

The destiny of the exuded serum is very variable. It may be absorbed
after an uncertain period of time—a condition effected chiefly by the blood-
vessels, especially the veins, though it is also undoubtedly taken up by the
connective tissue cells and the lymphatics where these exist, or it may remain
indefinitely, and require surgical interference for its removal. It may, how-
ever, be stated in general terms that the absorption of this product of inflam-
matory action invariably ensues upon the total cessation of those conditions
in which it had its origin.

When the exudation remains, and indeed sometimes in the shortest time
after its outpouring, various elementary forms, visible only by the aid of the
microscope, can be observed in it. These are, first, granules of variable size,
which are either inorganic, composed of some nitrogenized material, or
minute particles of fluid fat, olein or olein and margarin, coated with albu-
men; second, masses of various sizes and shapes composed of numbers of
the above granules aggregated together; third, cellules which are not to
be distinguished from those which will be hereafter described in connection
with the subject of lymph, and which have undoubtedly a similar origin.
Besides these, fine cholesterin plates can often be detected.

## § 2.—Of Lymph or Fibrin.†

In many inflammations, especially those in which the surface of serous
membranes is involved, or those affecting the areolar tissue of the body, a
peculiar jelly-like substance makes its appearance during the progress of the
inflammation, to which the designation of lymph, or coagulable lymph, or
the synonyms given below, have long been applied.

This substance is quite analogous in its chemical and physical properties
to the fibrin of the blood, and was originally supposed to be a special secre-
tion of the vessels of the inflamed part. At a subsequent period, when its
resemblance to the blood fibrin was more fully elucidated, it was supposed that
during inflammation an increased quantity of liquor sanguinis was exuded

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* See Paracentesis Thoracis and Abdominis, Hydrocele, etc.

† *Syn.*—Lymphization; fibrinization; fibrinous exudation; exudation of lymph;
coagulable lymph; plastic lymph; nutritious juice; natural balsam.

from the vessels, of which the fibrin coagulated, while the more watery parts were sometimes absorbed, sometimes exuded from the free surfaces of the body, and sometimes retained in the serous cavities.

So firmly established were these views thought to be, that Rokitansky and others of the Vienna school, with Bennett of Edinburgh, made the exudation or deposit in the tissues of fibrin from the blood the essential condition and criterion of every inflammatory act.

If, however, the recent doctrines of Virchow and Addison on the cellular pathology are correct, this ground must now be abandoned, and coagulable lymph be looked upon as a product or metamorphosis of the liquor sanguinis *formed in the* inflamed part by the influence, energy, and increase of the component cells of the tissue affected. Inflammatory lymph is still to be regarded as fibrin, but not as fibrin derived by transudation or exudation from the blood, but rather as fibrin of new formation created by cell action, or a production out of material furnished by the blood—as a fibrin, in short, which has as yet never circulated, though it is capable of being absorbed, and thus leading ultimately to an augmentation of the fibrin of the circulating blood beyond the normal standard. In support of this as of other theories much might be said, were it appropriate to our present purpose.

Whatever may be regarded as the precise mode of origin of fibrin, it will be found, when studied with the microscope, to be composed of the following minute characters :—

1. It will be more or less distinctly fibrillated, these fibres giving it the appearance of being composed to a great extent of innumerable very delicate fibrils, interwoven together so as to form an intricate net-work. This

Fig. 133.



A view of the formation of Fibro-Cellular Tissue by changes from the Lymph-Corpuscles.
(After Paget.)

appearance is quite similar in all its particulars to that noted in the coagulated fibrin of normal blood.

The fibrillated appearance above described is much less marked in some cases than in others, and in depraved or adynamic constitutions is often entirely absent, the fibrin presenting a granular appearance in which little or no fibrillization can be seen.*

2. Imbedded in the fibrinous mass above described can be seen numerous nucleated cells, which have been variously designated as exudation corpuscles, lymph cells, plastic corpuscles, etc. These cells, when complete, are spherical or nearly so in shape, with one or more nuclei; and their characters will be well understood when it is stated that they are generally undistinguishable from the white corpuscles of the blood on the one hand, and

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* Paget, Lecture, p. 220; also Rokitansky, vol. i. p. 82.

from the pus corpuscles on the other.* They may be more minutely described as possessing a delicate wall, which may be structureless or appear

Fig. 134.



A view of the Corpuscular Lymph Cell is given in the first figure of the row; the progress of this cell in fatty degeneration, and in the distention and absorption of its investing membrane, is shown in the remaining portion of the cut. (After Paget.)

to have numerous minute granules imbedded in it—contents which may be clear, contain a few granules, or so many granules as to obscure the nucleus, and one or several nuclei insoluble in acetic acid. It has been suggested that plurality of nuclei has the significance of commencing multiplication by division.†

Like other elementary forms, these cells vary greatly in size, the average being about $\frac{1}{2800}$ of an inch.

Considerable diversity of opinion, as already stated, exists as to the origin and mode of development of these cells, the prevailing theory, until a very recent period, being that they arose, according to Schwann and Schleiden's doctrine of free-cell development, in the blastema afforded by the inflammatory products.

According to Virchow, however, their true origin is to be found in the multiplication by division of the component cells of the tissue involved, and especially of the connective tissue cells or corpuscles.

In accordance with the perfection of its fibrillization, and the predominance of the fibrillated substance on the one hand, or of the exudation corpuscles on the other, lymph will present various external and minute characteristics, which, as they correspond with certain peculiarities in the history of individual cases, have led to the discrimination of two varieties: 1. Fibrinous lymph, or plastic exudation. 2. Corpuscular lymph, or croupous fibrin.

**1. Fibrinous Lymph** is lymph in which the fibrils predominate, the nucleated cells and granules being at a minimum. This is the *fibrinous lymph* of Paget, the euplastic lymph of former writers, and corresponds sufficiently well with the plastic fibrinous exudation of Rokitansky to be considered as identical with it.

This lymph presents to the naked eye a grayish or yellowish-white semitransparent color, possesses much toughness and elasticity, and adheres closely to the surrounding parts. Dynamically this variety of lymph is distinguished by its great capacity for development into tissue.

**2. Croupous Fibrin** is lymph in which nucleated cells are at a maximum, the granules and minute oil globules being also abundant, the fibrils being reduced to a minimum, or being altogether absent, and the fibrin represented in part or entirely by a coagulated granular mass.

This variety corresponds well with the croupous fibrin of Rokitansky, and it agrees also with many of the forms referred by Mr. Paget to his corpuscular lymph, and with the cacoplastic lymph of other authors. Lymph of this variety is distinguished by its yellowish or greenish-yellow color, by the absence of tenacity or toughness, and by its total incapacity for development, the changes which it undergoes being essentially of a degenerating order.

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* See Wedl, p. 297.                    † Ibid., p. 300.

It must, however, be understood that the foregoing division of lymph into two varieties is a purely arbitrary one, only justifiable on the ground of convenience, innumerable transition forms presenting every grade of intermixture between the two extremes which have been selected for description.

The **cause** of this diversity in the morphology and destination of lymph is of great interest. It has been clearly shown by Rokitansky, Paget, and others to depend in many instances upon constitutional peculiarities. In the inflammations of cachectic, depraved or disordered constitutions, lymph abounding in exudation corpuscles, and devoid of capacity for development, is of common occurrence, lymph, rich in fibrillated fibrin, with comparatively few cells, yet endowed with a great tendency to development, occurring under favorable circumstances in the inflammations of healthy constitutions. But besides the varieties in the nature of lymph due to constitutional peculiarities, a like diversity exists in many instances in which no constitutional peculiarity can with propriety be affirmed, and we are obliged, therefore, to admit that a diversity in the character of the lymph, such as has been above described, may result from the diverse characters of the local process. We are not, however, at present, able to account satisfactorily for this fact.

The **destination** of lymph will depend upon its situation, quantity, etc., but also, it must be especially observed, upon the fact that it partakes more or less completely of the characters of one or other of the varieties first indicated. As a general rule, it may be stated that, after a variable period of time, lymph either organizes or undergoes one of several degenerations.

1. **Organization of Lymph.**—The organization of lymph is shown by its transformation into one or other of several elementary tissues, white fibrous and yellow elastic tissue, cartilage and bone being the most frequent products derived from this source. The new formations thus produced may be highly vascular, contain lymphatic vessels, according to Schrœder Vanderkolk, and perhaps at times even nerves.

In these developments a tendency is exhibited, on the part of the new formation, to approximate more or less closely to the characters of the tissue in connection with which it occurs. Thus the lymph produced about the seat of fractures and beneath the periosteum, in periostitis, is likely, when developed, to produce bone; the tendons, areolar tissue, and epithelia being also more or less perfectly reproduced after injuries. The more complex tissues, however, such as the striped muscular fibres, are not readily reproduced, but are replaced after injuries, by a tissue identical in its characters with the general connective or fibro-cellular tissue of the body.

The elements of the tissues thus formed arise from the transformations which the exudation corpuscles undergo, and are very similar to the process by which the same tissues are produced in the embryo through the metamorphoses of the primitive embryonic cells.

As is well known, developing lymph becomes **vascular** at a very early period of its history. The precise mode in which this process is accomplished is, however, not yet definitely determined. According to Wedl, Rokitansky, etc., blood-vessels containing blood may arise in the midst of the lymph, and only subsequently become connected with the vessels of surrounding textures; while according to Paget this never occurs, blood-vessels always reaching the lymph by prolongations or outgrowths from the vessels of neighboring parts. Paget describes this process in the following words :—

"Suppose a line or arch of capillary vessels passing below the edge or surface of a part to which new material has been superadded. The vessel will first present a dilatation at one point, and coincidently, or shortly after, at another, as if its wall yielded a little near the edge or surface. The slight pouches thus formed gradually extend, as blind canals or diverticula, from

the original vessel, still directing their course toward the edge or surface of the new material, and are crowded with blood corpuscles, which are pushed into them from the main stream. Still extending, they converge; they meet; the partition wall that is at first formed by the meeting of their closed ends clears away, and a perfect arched tube is formed, through which the blood, diverging from the main or former stream and then rejoining it, may be continuously propelled."* By a repetition of this process, any number of capillary loops may be formed extending into the new tissue.

Fig. 135.



A Diagram of the "Fusiform Enlargement." (After Paget.)

Paget also describes the formation of blood-vessels by another process, to which he applies the designation "Channeling," in which, after the formation of diverticula, as in the last case, their blind extremities burst, and the blood which escapes works for itself a channel in the developing tissue around which, subsequently, a vascular wall is formed. The existence of such a process is, however, exceedingly problematical.

Fig. 136.



A Diagram illustrative of the "Channeling Process." (After Paget.)

The new blood-vessels, when first formed, possess simple, structureless walls, and are therefore true capillaries. At a subsequent period, however, they may acquire greater size, and all the complex structure of small arteries and veins. As a general rule, pathological vessels present much thinner parietes than normal vessels of the same diameter.

The varied changes and structures resulting from the organization of lymph have been described by pathologists as "inflammatory induration," "false membrane," and "reparative material." As the latter is especially important to the surgical student from its intimate connection with the healing of wounds and ulcers, the mode of its production, etc. demands at present special consideration, and will be examined as shown in the "Adhesive process," in "Granulation," and in "Cicatrization."

It is difficult, in view of the constant necessity in surgery for studying the adhesive process, to over-estimate its importance, the repair of the slightest cut or the most extensive wound, as well as the healing of every cutting operation, and especially of the class designated as "Plastic" or "Taliacotian," being dependent for its success upon this process.

In the repair of injury, the restoration of lost tissues by ulceration, and in the after-treatment of operations, the surgeon's success will be mainly dependent on his correct comprehension of the formation and organization of lymph.

2. Of the Adhesive process, or Adhesion.—When, in consequence of a

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* Paget, op. cit., p. 146.

wound or recent mechanical solution of continuity, lymph is formed, such changes may ensue as will either close the solution by direct agglutination, or the "union of the first intention" of McCartney, or by "adhesive inflammation," or such changes as ensue upon the inflammatory process; while "granulation" and "cicatrization" are the later stages of the repair, by the organization of fibrin.

Adhesion as the result of the metamorphosis of lymph may occur—1st. As "union by the first intention," the lymph in this case being promptly deposited on the edges of the wound from the blood, as it flows over them. It is rarely seen, being usually noted only in superficial wounds of a limited extent, as in punctures with the bistoury or lancet, and superficial incisions of a circumscribed character. 2d. Union by "adhesive inflammation," or by "adhesion" of Hunter, or the "primary adhesion" of Paget, or that mode of repair that is most commonly seen in the prompt union of wounds.

The lymph which is the bond of union in these cases is that before alluded to as the result of the inflammatory process, and its amount depends very much on the distance of the sides of the surface to be repaired. Hence the advantage in the healing of wounds, of approximating the adjacent surfaces. When approximated, the lymph being of a small amount, the new tissue formed from it is small, and the scar or cicatrix is correspondingly diminished. Whether we regard this lymph as the result of an exudation from the blood, in consequence of inflammatory action, or as due to increased irritability of the component cells of the divided tissues, still it must be admitted that the main agent in deciding the character of the new reparative material is "cell action." To regulate this is to regulate inflammation—a point of much importance in surgery, and to be accomplished by carrying out the local and general treatment of inflammation hereafter described, it being constantly remembered that the tendency of inflammatory action is destructive, it being rather disposed to degeneration than development. In fact, though spoken of as *adhesive inflammation*, union by the lymph thus formed is not accomplished until the inflammatory process has ceased; while, as Paget has remarked, inflammation lasts, fresh lymph will be continually exuded, and rather hinder than aid the process of development, the freshly-formed lymph being less and less prone to organization in consequence of the impaired nutritive power that ensues upon a continuous inflammatory action. This he illustrates by referring to what is seen in pleurisy, where the layers of lymph next to the pleura are more prone to organization than the later-formed layers.* An inflammation that continues in a wound tends therefore to retard union by adhesion, and is favorable rather to the production of pus cells, or suppuration and granulation. The natural tendency of the lymph, noted as the result of moderate inflammatory action, is to form fibro-cellular or connective tissue, and this structure constitutes therefore the basis of all union by adhesive inflammation. The peculiar tissue that is ultimately found as the result of this adhesive process will be governed by the special cell action of each tissue in which inflammation is developed, varying in the skin, serous and fibrous tissues.

The phenomena noted in the adhesive process are presented at periods which vary considerably under different circumstances, especially whether the process is or is not exposed to the action of the atmosphere, it being most prompt and perfect when the air is excluded—a fact well proved by the various observations of Hunter, Duhamel, and others.

3. Union by the "Second Intention," or by "Granulation."—The organization of lymph and the formation of its blood-vessels having been

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* Op. cit., p. 230. Phila. edition.

already alluded to, and the development of the latter by outgrowth admitted, it is easily seen that all such vascular outgrowths must be covered by lymph, and thus create, in an open wound or sore, numerous conical papillary projections, of a bright-red color, from the thinness of the vascular coats permitting the red corpuscles of the blood to show through them, while the

Fig. 137.
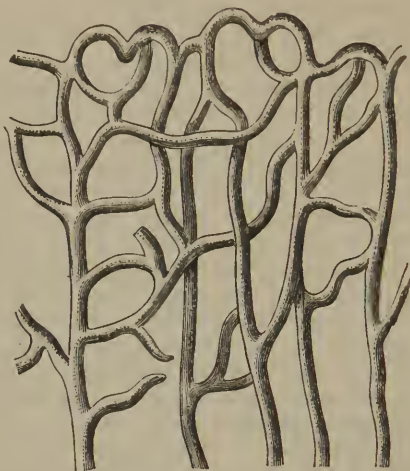


lymph that intervened between the eye of the observer and the enlarged vessel would give them a clear, moist, varnished-like surface. Such a healing surface, when of an arterial hue, is designated by surgeons as a "granulating surface," the papillary projections or conical eminences of lymph, with the subjacent distended vessel, being known as the "granulations."

As the healing of ulcers and of wounds, and the whole process of repair, when not promptly accomplished by "adhesion," is the result of the formation of healthy granulations, their external character as well as their changes have been carefully studied.

Granulations.—A granulation consists of one or more capillary loops imbedded in a mass of nucleated cells in various stages of development, those on the periphery being the least advanced. Indeed, the peripheral cells, which are constantly multiplying, are, as a general rule, simple spherical *exudation corpuscles*, in which the transformation into tissue has not yet commenced. Of these the most superficial degenerate, and are constanly cast off as the "*pus corpuscles*" of a healthy pus; this pus protecting the subjacent layer from the depressing influence of cold, dryness, and chemical change. Consequently, the pus of a healthy granulating surface should be regarded as a mild natural dressing, and not officiously removed by washing, etc., under pretense of extreme cleanliness.

Granulations differ considerably in character, according as the healing process is healthy and reparative or the reverse.

**Healthy Granulations** are florid, smooth, moist, shining, and do not bleed readily; although, of course, rough handling will cause an effusion of blood. They seldom rise above the level of the skin, but having reached that point, they coalesce laterally and form a cicatrix, in the manner that will be presently described. From various causes, however, which are sometimes constitutional and sometimes local, the process of granulation may deviate from its natural mode, and the granulations are then called unhealthy.

**Unhealthy Granulations** are pale and flabby, or livid, bleeding upon the slightest touch, or even on the motion of the part; they have a tendency to become excessive in their growth. Exuberant granulations are vulgarly known as "proud flesh," a condition which is much feared by patients, who frequently apply to surgeons with great anxiety to be relieved of the consequences of this growth. Exuberant granulations are, however, generally harmless, at most only retarding cicatrization. They are easily removed by means of a little nitrate of silver, burnt alum, or similar mild escharotics. The treatment appropriate to the regulation of the condition of granulations, whether healthy or unhealthy, will be given in connection with the treatment of the simple healthy ulcer. When healthy granulations reach the surface of the skin, they cease to grow, and the peripheral cells undergo transformations by which they assume the characters of epidermal cells. This change is technically described as the process of cicatrization.

**4. Cicatrization.**—Cicatrization has for its result the formation of a *cicatrix*, or, as it is called in common language, a *scar*. This transformation begins on the circumference of a granulating surface, and gradually extends toward the centre; but sometimes little points of cuticle form and skin over near the cicatrizing edge, yet quite distinct from it. If these points be examined by the microscope, it will be found that the cells on the surface are flattened into scales and have the epidermal characters.

A cicatrix when first formed is redder than the surrounding skin, but it gradually contracts, becomes less vascular and finally much paler than the adjacent skin. The cicatrix, with the whole of the subjacent new textures, is sometimes spoken of as "Inodular tissue."

The further consideration of cicatrization, and the influence of lymph in the repair of lost tissue, will be reserved for the subject of Ulcers and Wounds.

**5. Degeneration of Lymph.**—Lymph may become inspissated in consequence of the absorption of its fluid parts, the elementary forms becoming shriveled, dry, and deformed, remaining as a more or less hardened mass for a variable period of time; or it may undergo such changes as will result in the deposit of the various salts of lime, thus producing a calcareous mass. Moreover, lymph may occasionally be completely absorbed, a destruction of the elementary forms of course preceding this process, fatty degeneration of the exudation cells being the means by which this transformation is effected. In this degeneration every transition form has been observed from the first appearance of a fatty granule or two within the cell to a stage at which the cell appears transformed into a mass of adherent oil globules, (compound granule cell,) which soon disintegrate and liquefy. The most important of these degenerations, to the student of surgery, is that into pus, which we may now proceed to consider.

### § 3.—Pus and Suppuration.

**Pus**, according to the best modern authorities, is invariably the result of a degeneration of fibrin or lymph, when exuded or formed as just described, and if we select as a typical example that which flows from a healthy granulating wound, it may be described as a yellowish cream-like fluid, neither acid, alkaline, nor corrosive, ordinarily without taste or smell, and mild and unirritating when it comes in contact with healthy structures. Pus of these characters consists of a *pus serum*, in which float the so-called *pus corpuscles* or *pus cells*. If the liquid be allowed to repose, the pus cells sink to

the bottom in virtue of their greater specific gravity, while the supernatant liquid, if decanted, can be studied separately.

Fig. 138.
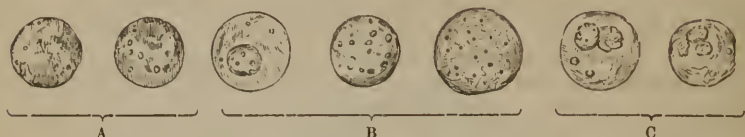


A VIEW OF PUS CELLS IN THEIR ORDINARY STATE.—Those at A are spherical. Those at B are swollen, and their contents diffused by the addition of water. Those at C present two, three, or four small bodies like nuclei, after the addition of dilute acetic acid. (After Paget.)

*The pus serum* thus obtained (as shown by Vogel) resembles to a certain extent the serum of the blood on the one hand, and the serum of inflammation before described, on the other; that is to say, it is an aqueous solution of albumen, fatty matters, and certain salts. The exact proportion of these several ingredients vary greatly. From the tables of Becquerel and Rodier* it may be seen that the solids in solution vary from 83–203 parts to the thousand of pus. Of 100 parts of these solids the corpuscles vary from 26–32 parts, and the albumen from 11–20 parts. The proportion of extractive fats and salts also vary greatly.

It is especially to be remarked that the proportion of *cholesterin and other fats* is considerably greater in the pus serum than in the serum of blood, or in inflammatory serum or lymph.

When pus is examined by the microscope, various elementary forms may be observed, which for convenience of description may be classified as essential and non-essential.

The *essential or invariable elements* are—

The so-called *pus cell* or *corpuscle*, which is a nucleated cell, identical, morphologically, with the exudation corpuscle before described. It is round, granular, and contains from 1 to 4 or 6 nuclei, which are rendered more distinct by the action of acetic acid. It measures, on an average, about $\frac{1}{3800}$ of an inch in diameter.

Formerly this cell was believed to be specific and its presence diagnostic of suppuration. But the several characters on which this idea was based have been found, one by one, to apply to similar cells in other normal and pathological fluids, and even those who are disposed to speak of the pus cell as possessing special characteristics are compelled to admit that we cannot "always distinguish lymph cells from pus cells."† The characters predicated of pus cells, as distinguishing them from the exudation corpuscles above described, are their more granular appearance, and the greater prevalence among them of a plurality of nuclei. But although we are constrained to admit these characters in many instances, yet they are not invariably present, and are simply an expression of the fact that the pus cell is an exudation corpuscle, which has lost its capacity for further development, or even begun to degenerate.

Besides the pus cells which vary greatly in quantity, granules of various kinds abound in pus, especially small globules of fat coated with a thin film of albumen. The great quantity of fat thus shown to be present in the serum of pus is a noteworthy feature of its composition.

The *non-essential or incidental elements of* pus are—plates of cholesterin, large drops or globules of oil, particles of partially disintegrated tis-

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* Loc. cit., Becquerel and Rodier, p. 570.        † Paget, p. 248, note.

sue, as shreds of areolar tissue, fragments of bone, etc ; and certain bodies, the results of commencing decomposition in the pus, as crystals of ammonio-magnesiates, phosphates, vibriones, etc.

The next point to be discussed is the *origin* of pus. Formerly it was supposed to be a distinct and peculiar effusion or exudation, but more recently it has been generally conceded to result in most cases from the fatty degeneration of lymph or fibrinous exudations, especially those in which the fibrin is but imperfectly fibrillated.

According to Virchow, the pus corpuscles are invariably the result of the multiplication by division of pre-existing cell forms, and hence while the pus corpuscle is in external appearances the same in all parts of the body, its precise genesis is not always the same. Thus in the suppurations of the mucous membranes, in cutaneous pustules, etc., the pus corpuscles are in fact aborted and imperfectly formed epithelial cells. In the deeper-seated parts they are, in many instances, the result of the degeneration of the so-called exudation corpuscles, which are themselves the result of the multiplication by division of the component cells of the involved textures, and especially of the connective tissue corpuscles wherever these exist. The degeneration of the exudation corpuscles is shown by their more granular and opaque appearance, but these characters are often absent. Sometimes, however, the degeneration is marked, terminating in their metamorphosis into masses of fat granules, (compound granular cells.) The time required to effect these changes is very variable, and constitutes the process of suppuration.

With this brief account of the origin and nature of normal pus, we may readily comprehend the several varieties described by authors, as ichor, sanies, etc.

**Ichor.**—By Vogel and others the term ichor has been limited to an acrid fluid, derived from pus, but in which the characteristic pus cells have disappeared, being destroyed by the corrosive liquid in which they float. By Rokitansky* and others, however, the term ichor is applied to any purulent fluid which exercises an irritating or corrosive influence upon the normal textures with which it is brought into contact. The ichorous qualities of this variety of pus pertain to the pus serum, and not to the corpuscles, as will be readily understood when it is considered that the ichorous qualities are most exquisite in those specimens which contain few or no corpuscles. Ichorous pus is thin and often greenish in appearance.

**Sanies.**—Ichorous pus is frequently colored by the presence of hematin, or even of blood, and is then called sanies.

**Sordes.**—This term has been applied to unhealthy pus rendered dark by dust, putrefying blood, exposure to the air, and decomposition more or less advanced. The same term has been applied to the peculiar brownish matter, more or less rich in accumulated epithelial scales and blood corpuscles,† which collects around the teeth in certain fevers.

Purulent fluids sometimes possess the property of conveying certain disorders from the individual to any other who may be inoculated by them. The instances in which this contagious property properly belongs to the pus are very few, probably that from syphilis, the vaccine virus, and small-pox being the only instances. In each of these cases the inoculated matter not only produces, wherever it may be inserted, a sore like that from which it was taken, but, if not interfered with, the peculiar constitutional affection is developed. We are unable, at present, to explain this fact, these varieties of specific pus, as they have been called, presenting no morphological or chemical peculiarities.

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* Rokitansky, p. 119, vol. i.
† Van Duben's Microscopical Diagnosis, Prof. Bauer's translation, p. 38.

## SECTION VI.

### ETIOLOGY AND TERMINATION OF INFLAMMATION.

The **Etiology** (αιτια, cause) of inflammation, or the causes of the changes in nutritive action before referred to tending greatly to regulate every rational plan of treatment, has always received a large share of attention, and few subjects have given rise to longer discussions or eliminated more diversified theories of its production than this of inflammation. It would, however, be impossible, in a general treatise, to allude to these theories in detail, and I shall, therefore, only offer a comparatively brief outline of the exciting, predisposing, and proximate causes.

### ¿ 1.—Of the Etiology of Inflammation.

The causes of inflammation may be classified as exciting, predisposing, and proximate.

The **exciting causes** of inflammation are very varied, embracing the entire class of surgical disorders, as frictions, pressure, irritants, wounds, etc., thus, in fat men, the friction of the scrotum against the thigh, or of a tumor against adjacent parts, will suffice to develop inflammation of the skin, while the pressure of the sacrum against a bed, of the heel against a pillow, or of various bands, splints, etc. against the surface of the body, will also create it. Unhealthy pus, wounds, and foreign bodies acting on normal tissues, will likewise rapidly develop the same condition.

The **predisposing causes** are plethora; anæmia; certain states of the atmosphere, as shown in the development of erysipelas; the habits of the patients, as intemperance; their age, or sex; and specific conditions of the blood, as scrofula, syphilis, or cancer, all of which present us with causes that will predispose the patient to inflammation, and very seriously complicate otherwise simple injuries.

The **proximate** or **essential causes** of inflammation present a wide field for study, and it is in connection with these that physiologists and pathologists have exercised their utmost powers of observation, and exhibited their greatest ingenuity in the formation of theories for the explanation of a condition which the use of their senses, even when aided by the microscope, did not suffice accurately to establish.

Among the various opinions advanced in regard to the proximate causes of inflammation are those of a "lentor" or viscidity of the blood, as suggested by Vacca in 1765; of an "error loci," or misplaced position of the blood; of "a spasm of the extreme vessels or capillaries," as suggested by Cullen; of increased action in the vessels themselves, as suggested by Hippocrates, but subsequently warmly urged by Hunter; or the debility of the vessels, as suggested by Allen of Edinburgh, and readvanced by Wilson Philip. The opinions of debility and stagnation, or increased circulation, have each been advocated by subsequent writers—Van Helmont, Stahl, Haller, and Thompson regarding inflammation as due to excessive vascular action, while Hastings, Henlé, and others sided with the opinions of those who saw in it debility of the vessels and consequent congestion.

It is, however, to modern writers—as Travers, Bennett, Wharton Jones, Williams, Carpenter, Lebert, Simon, and Weber—that we are mainly indebted for most of the positive information that we possess of the actual condition of an inflamed part.

These observers have, from the examination of inflamed parts with the microscope, satisfied themselves that, under the effects of irritation, the flow of blood in the capillaries is first accelerated, but that very soon the red corpuscles oscillate backward and forward, the blood stagnates, and the vessels become distended ; that sometimes a vessel ruptures and its blood escapes into the surrounding tissues, while the liquor sanguinis, often colored with hematin, is exuded by exosmosis or perhaps drawn out by the function of the organic cells near it, the redness of inflammation being due to all of these causes, as before stated when discussing the nature of inflammation.

Among the best accounts given of the proximate effects of such causes as will develop inflammation is that furnished by Paget,* to which the reader is referred for a full statement of this and many other points illustrative of the action of the minute vessels as shown not only in inflammation, but also in the repair of tissues, inflammatory action being frequently associated with the reparative process.   As objection had been raised to such observations as had been made upon the web of a frog's foot—on the ground of its being a cold-blooded creature, and therefore possessed of a circulation unlike that seen in man—Mr. Paget experimented on the wing of a bat, which more closely resembles warm-blooded vertebrata.   In this creature he noticed that if, while "the blood was circulating in the vessels—as in a companion artery and vein—a fine needle was drawn across them three or four times without apparently injuring them or the membrane over them, they both soon contracted and closed ; that, after thus remaining for a few minutes, they began to open, and, gradually dilating, acquired a larger size than they had before the stimulus was applied.   He now noticed that, as the vessels were contracting, the blood moved more slowly, then began to oscillate, until at last it ceased to move—the state thus induced in the vessels being similar to what is commonly understood by the expression 'active congestion' or 'determination of blood' to a part, and being due to a general enlargement of the vessels themselves, as well as to the increased velocity of the blood in them."

Thus far facts which are well known have been presented in explanation of the immediate cause of inflammation ; but when we come to the rationale of this action, and endeavor to explain how inflammation is produced, we reach the unsatisfactory ground of pure theory.   Of theories there have been all the varieties before alluded to as the opinions of those whose names have been quoted, and as a fuller description of them would not furnish any facts of value in the treatment of inflammation, I will only state that the following seem to offer the most satisfactory explanation of the action of these causes that can be given in connection with the development of inflammatory action from surgical causes :—

1. That the starting-point of inflammation is the sense of injury felt by the organic nerves, as stated by McCartney.   This involves the important practical point that inflammation, after an injury, may be checked or regulated by such means as will tend to soothe or allay the nervous irritation.

2. That the original irritation of these nerves produces disordered action not only in the capillaries, blood-vessels, and blood, but also in the living properties of the adjacent tissues as an organic entity—that is to say, in the component cells of the tissue affected—as was stated by Travers.†

3. That the first contraction of the capillaries, as described by Mr. Paget and seen in the bat's wing, is due to the action of such portions of the coats of the capillaries as correspond with the circular fibres of the larger blood-vessels, while their subsequent dilatation is due to the action of that portion

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* Lectures on Surgical Pathology.   Phila. edit., p. 198.
† Travers on Inflammation.   1844.

of the vessels which corresponds to the longitudinal fibres of a muscle or the elastic coat of the larger arteries, which, by shortening their length, causes the oscillatory movements of the blood corpuscles—the relaxation of the walls in the approximation of the two extremities of a vessel permitting the lateral expansion of its coats and the subsequent stagnation or conges- tion of the blood.

These explanations, it is admitted, are purely theoretical, but yet there are some facts which tend to support them.

### § 2.—Terminations of Inflammation.

It has been shown that inflammation was the perversion of the natural preservative action of a part, and that it was characterized by certain changes in cell action of the tissue affected, the effect of the local vascular and nerv- ous action. It now remains to inquire, what are the results of these changes— in other words, its terminations; and these may be briefly mentioned as deli- tescence, resolution, metastasis, cure or death.

**Delitescence** is the term employed especially by the French surgeons to indicate the cessation of inflammatory action, and the restoration of normal healthy action in a part that was inflamed, before the inflammation has re- sulted in marked change of nutrition, or occasioned any structural change. It is the most rapid and perfect cure of inflammation, and may occur spon- taneously, or under slight treatment. An example may be found in the inflammation developed by a splinter in the flesh, which often disappears promptly on the removal of the cause.

**Resolution** indicates the prompt, yet more gradual, cessation of inflamma- tory action before it has run on to suppuration, or created such local destruc- tion as would require marked reparative effort. The formation of serum or lymph in an inflamed tissue will not prevent a termination of the disorder by resolution, and the entire restoration of the part to its normal condition, without any evidence being left of its having been inflamed. On the occur- rence of resolution the symptoms of inflammatory action gradually subside, and, though the local action may be feeble for a few days, the structures soon regain the condition of health. The prompt and judicious curative treatment of inflammation favors a termination by resolution.

**Metastasis** means the sudden disappearance of inflammation from one part and its development in another. How it is effected is not clearly understood, but is probably the result of nervous communication influencing the cell action of similar though distant tissues, as when inflammation of the parotid gland leaves its first seat and is located in the testicle, or when a blow on the head develops abscess of the liver.

The regulation of inflammatory action, and its termination in some mode that may be reparative in its results, is the object usually sought for and ac- complished by the means hereafter described in the surgical treatment of inflammation.

The destruction of cell action and the death of the inflamed part, which is the last result of inflammation, will be referred to subsequently, under the heads of Ulceration and Mortification.

# SECTION VII.

The surgical treatment of inflammation involves, in nearly every case, the consideration of the question of its tendency, whether useful or injurious; there being, in numerous instances in surgical practice, a necessity for the increased formative power that results from the local nutrition being kept within proper bounds during inflammatory action.

Its treatment may, therefore, be studied under two distinct heads: first, as local; second, as general or constitutional, both being often demanded in surgery, in order to obviate the evils that would otherwise ensue from accidental or operative injury of structure. They may be best studied separately, though employed conjointly in practice.

## § 1.—Local Treatment.

The indications for the local treatment of inflammation are to be found in the avoidance of all sources of irritation, or increase in the local circulation, by preventing the access of the atmosphere to the surface; the passage of acrid discharges over unprotected parts, or such chemical changes in the discharges, from inattention to cleanliness, as will create irritation. These indications may be fulfilled in various ways, as by covering the adjacent tissues with adhesive plaster, collodion, or ethereal solution of gutta-percha, very lightly applied; or by the application of bran, starch, or other dry powder; or by mucilages, oil, and cerates, though the last are specially liable to chemical changes; or by relieving parts of pressure, as by change of position, or by the use of soft pads and pillows; or by modifying the arrangement of splints and bandages, when these are required.

Among the valuable local measures especially useful in checking extreme action are the applications of cold, or tepid, or hot water, to regulate the temperature of the part, as by means of the *water-dressing* or *irrigation*, before described, p. 100.

Another measure often resorted to is the local abstraction of blood, a means of treatment especially useful in the local inflammations resulting from injuries. In these cases, where the vessels are rendered turgid, and the cell action of the tissues adjacent to the injury is increased by the irritation developed by the injury itself, the local abstraction of blood at an early period will frequently prove a most efficient and valuable treatment, and in cases of rupture of the vessels and subcutaneous hemorrhage, often aid its removal, although some writers have recently doubted the utility of the measure, as will be hereafter specially alluded to in the consideration of the propriety of blood-letting in inflammation. The local abstraction of blood may be effected either by leeches or by cups.

**Application of Leeches.**—The application of leeches may be accomplished by placing a few of them in a small empty cup, Fig. 139, A, smearing a little blood from the finger, or a little sugar and water upon the skin, and then, holding the cup near the part—as the temple—permitting the leeches to crawl out of it on to the skin, where they will readily attach themselves, provided the part has been thoroughly cleansed, or shaved, if necessary, prior to their application. When full, leeches drop off without difficulty, and should be immediately placed in another cup, Fig. 139, B, until they can be permanently

deposited in a jar of water, for subsequent use, after they have disgorged or digested the blood drawn. If sufficient

Fig. 139.



blood has not been taken by the leeches, the bleeding may be subsequently encouraged by fomenting the part with warm cloths; but, when leeches have drawn as much as is desired, a piece of oiled linen applied to their bites is all that will be requisite. If any bite bleeds too freely after the leech has been removed, the hemorrhage may be checked by touching it lightly with a sharp-pointed pencil of the nitrate of silver, or by pressing on it a little dry lint. When it is desired to circumscribe the application of leeches, they may be placed on the part moistened with a little blood or sugar and water, and then covered for a few minutes with a tumbler; or a single leech may be applied to any special point, as the canthus of the eye, Fig. 140, the nostril, etc., by placing it in a glass tube

Fig. 140.



open at both ends, and then applying the tube to the part from which the blood is to be abstracted. Six American leeches will draw about one ounce of blood, though one European or Swedish leech will often draw fully this amount by itself.

**Mechanical Leeches.**—A substitute for the leech was suggested some time since by Alexander, of Paris, and consisted of small glass tubes with beveled ends, the air within each one being exhausted by a very ingenious and simple mechanism. Applied to the surface of the body, the mechanical leeches acted like small cups, and thus produced congestion of the superficial vessels, when a small metallic tube, containing a three-bladed or triangular lancet, was applied, so as to make a puncture of the skin; after which the glass leech was reapplied as often as necessary, precisely as in the ordinary operation of cupping.

In several instances in which these leeches were employed they acted

well, and satisfied me that, to the country practitioner, under ordinary circumstances, they would prove useful, although they cannot supplant the aquatic leech, especially in the abstraction of blood from small regions, as the eyelids, gums, nostrils, rectum, etc.

Cups.—The abstraction of blood by cups may be accomplished by exhausting the cup, by means of an air-syringe, as furnished by the cutler, or by forming a little cone or thimble of letter-paper, by twisting a strip of it around the end of the finger. On dipping the base of this cone into a little spirits of wine, touch it to the flame of a candle, toss it into the cup, and apply the latter directly on the skin. As the twisted end of the cone is the heaviest, it will generally be found to rest upon the skin, and thus keep the ignited portion from burning the patient, the combustion being promptly checked by the want of air within the cup. After the vessels of the skin have been rendered turgid

Fig. 141.



beneath the exhausted cup, remove it, by gently inclining it to one side, so that the air may enter it from beneath. Then applying the "scarificator"— or scarifying the skin by numerous punctures with a bistoury or lancet— reapply the cup until sufficient blood is drawn to accomplish the object.
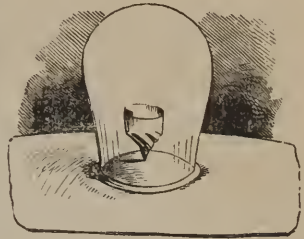
Cups thus applied not only abstract blood, but also draw it to the surface of the skin, and create marked congestion of the neighboring superficial vessels and tissues, thus inducing increased cell action in the part and a diminution of that in adjacent parts. Hence the application of "dry cups," or those not followed by scarification of the skin, is often a most valuable local measure. In cases of congestion of the vessels of the brain the application of dry cups to the back of the neck is highly useful; and so in many other regions.

As the blood is thus attracted to one point, and the amount flowing to some other is diminished, this and other means acting on the same principle of relieving increased cell action in one point by augmenting that in another, are usually designated as "counter-irritants."

"Counter-irritants" may be employed as prophylactic or as curative measures in the treatment of inflammation. They may be employed simply to increase local vascular action, as limited to fullness of the vessels, or carried so far as to result in increased cell action of an evacuating character, the result being mainly due to the degree of irritation thus developed. The first are generally designated simply as "Counter-irritants," while the latter are alluded to under the head of "Exutories," "Issue," or "Drains."

Counter-irritation may be practiced on the sound skin by applying to it some stimulating substance, as aqua ammoniæ, croton oil, tartar emetic ointment, cantharidal collodion, or the old-fashioned blistering plaster. In any case the action of these articles may be continued until such increased cell action is developed as will result in vesiccation or pustulation, that is, in the formation of serum or pus in the tissue irritated.

The Actual Cautery, or iron heated by immersion in boiling water, and then drawn lightly in lines over the skin, may be employed so as to redden the part, and thus produce irritation. The hot iron, however, creates fears which render its use often objectionable, and there is nothing in the irritation that it induces which cannot be obtained in a less frightful manner by the employment of other remedies. To the thick skin of horses it seems appropriate, and its use should be mainly restricted to veterinary practitioners.

Issues are drains that are most generally formed by the action of some

substance which, by destroying the tissue, induces a discharge in consequence of the efforts of nature to repair the damage. Two classes of agents possess this power—1st. Chemical Agents, or Caustics, as commonly designated. 2d. Heat, or the actual or potential cautery. Each of these means, by destroying the organization of the skin, creates a dead mass called an Eschar. This, being thrown off by nature, leaves a cavity which, being filled with issue peas, or some irritating substance, is thus kept open and continues to discharge.

Chemical Agents, or Caustics, are those most commonly employed. They may be used in three forms, solid, liquid, and as paste. Of the solid kinds, we have the Potassa, or Kali Purum; the Nitrate of Silver; the Bichloride of Antimony; the Chloride of Zinc, etc.; all of which act in the same manner. The caustic potash being readily obtained, and prompt in its effects, is the one most generally preferred.

In using this article, select such a spot for its application as will not involve any deep-seated important parts. Thus, superficial joints, arteries, nerves, bones, etc., should be avoided, lest the action of the caustic extend to them, and produce serious injury. Issues should, therefore, be established in the fleshy part of the arm, or thigh, or on the back of the neck, or along the spine. If we choose the thigh, the depression which exists on its inner side, just above the knee, will be found convenient; if the arm—and this is most common—take the space between the biceps and the deltoid, near the insertion of the latter. Then laying upon the spot selected a piece of adhesive plaster, or kid spread with soap cerate, with a hole in its centre of the size desired for the issue—generally about three lines in diameter—rub the integuments within this hole with a piece of the caustic potassa till they become black, and repeat the operation each day, if necessary, until an eschar is obtained of the desired depth. This usually should not be deeper than the integuments, lest it extend beneath the fascia, and produce subsequent trouble. Or we may place in the opening of the plaster a piece of potassa, about the size of a hemp-seed; cover this with a strip of adhesive plaster, and apply over it a compress and bandage. After twelve hours, on removing the plaster, apply the warm-water dressing, in order to hasten the separation of the slough, which on coming away will leave a deep circular ulcer. This ulcer should then be filled with three or four peas made of orris-root or gentian, which, by absorbing the moisture, will swell and distend the part. Should these, however, not prove sufficiently irritating, dress the sore with basilicon, mezereon, or some other stimulating ointment.

The daily dressing subsequently resorted to must depend upon circumstances.

Fig. 142.
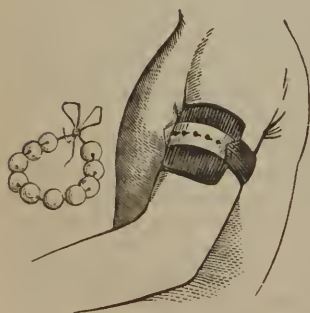


If fungous granulations arise, they must be repressed by the nitrate of silver; suppuration kept up by moving the peas, and by the ointments just stated; and too much inflammation prevented by the use of the water dressing and mild cerates. The removal of the peas and the use of simple dressings generally suffice to heal the sores.

In order to protect the ulcer from accidental injuries, and also to keep the patient's clothes from being soiled by the discharge, it is usual to cover the part with a small plate of tin, or some other light metal, moulded to its shape, and fastened by an elastic band so as to surround the limb. These little bandages are generally kept by the cutlers or druggists, and add much to the patient's comfort, Fig. 142.

When, in the production of an issue, any apprehension exists of the action of the caustic extending too deep, we may neutralize it by an appropriate article. Thus, washing the part with vinegar will neutralize the action of caustic potash; salt and water, that of the nitrate of silver; magnesia, or some other alkali, that of sulphuric acid, etc.

The formation of issues by incision has so little to recommend it, that I shall pass it by.

When other means cannot be had, iron heated in the fire may be substituted for the caustics just mentioned. Heated to a white heat, and applied directly to the skin, the actual cautery immediately produces an eschar, which follows the same course as that created by caustic. The objections of patients and the greater convenience of other means have, however, thrown this mode of creating an issue out of general use.

**Moxa.**—This is the name given to little rolls of inflammable matter, intended to cause eschars, by being allowed to burn upon the integuments until they cause its destruction. They are made of various substances, as cotton, lint, tow, etc., soaked in a saturated solution of nitre; then dried and wrapped up in little bags, or covers of silk or muslin, sewed together at the sides, formed into rolls and coated with gum. Or, the common punk, as found in the shops of the tobacconist, cut into pieces about an inch long, will answer the same purpose. The application of any of these cylinders is very simple. Having chosen a spot where the adjacent parts of importance are not likely to be injured by the extension of the inflammation, place upon it a piece of moistened cloth, with a hole in its centre large enough to receive the moxa. This cloth is intended to preserve the surrounding parts from the sparks which sometimes escape. Next, see that the end of the moxa is applied to the part perpendicularly, so that it may fit itself accurately to the surface; then moisten it with a little gum to make it adhere, or else hold it firmly on the part by a pair of forceps, or a porte-moxa or metallic ring, as shown in Fig. 143. Having now lighted one end of the cylinder, keep up the combustion by the breath, or by a pair of bellows, the
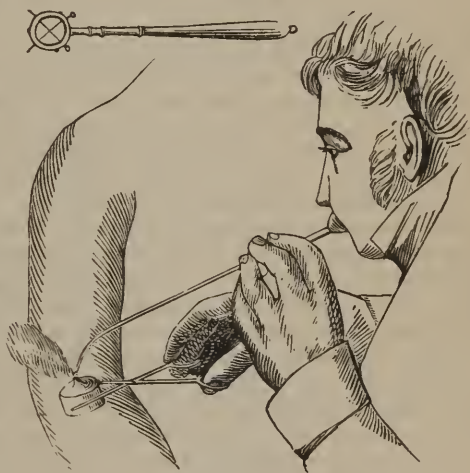
Fig. 143.



latter being necessary where the smoke irritates the bronchia too much. On its application and burning, the patient first feels a gentle heat, which gradually increases, until, as the fire approaches the part, the pain for the moment becomes excruciating, but diminishes as the fire destroys the vitality of the skin. The eschar thus formed being afterward treated like the eschar created by caustic, the issue is readily formed, when the subsequent treatment will be similar to that previously described. Moxa, however, are now rarely resorted to.

An **Electric Moxa** has been recently recommended by Golding Bird, which is a modification of one long known, as suggested by Humboldt and Grapen-

geisser, and usefully employed both in Europe and America.    It is applied
as follows: Make two blisters by blister-plaster, in the usual way, of the
size of a Mexican dollar, the one below and the other above the affected
part.    Place a silver plate the size of a silver dollar on the lower raw
blistered surface, and a zinc plate of similar size on the upper blistered sur-
face, placing a piece of lint, wet with salt and water, over each plate, and
covering them with a piece of silk velvet; then twist together the wire
attached to each plate, taking care that the wire does not touch the skin or
the wet cloths, and bind the whole in position by a bandage.    In a few
hours the blister under the zinc plate will be covered with a white film or
eschar, caused by the chloride of zinc, that will separate in four or five days
and leave a free suppurating surface, the formation of which is usually pain-
less.    The zinc plate should be applied nearest to the head, and the silver
plate to the most distant point.*

The Sulphuric, Nitric, and Hydrochloric Acids are occasionally employed
when some objections exist to the means just stated.    In order to use them,
steep a small compress of patent lint, fixed to the end of a small piece of
wood, in the liquid, and apply it directly to the skin, guarding against the
extension of the acid over surrounding parts; the eschar will then be made
as before stated.    In cauterizing the bites of rabid animals, the liquid caus-
tics are preferable to the others, as they spread more rapidly; but the wound
should in these cases always be enlarged previous to their use.

**Of Setons.**—A Seton is one of our most powerful means of keeping up a
cutaneous discharge.    Strictly speaking, the seton itself is merely the band
or substance employed to irritate the part; though the name is often given
to the operation by which this band is introduced beneath the skin.    Its
application is now very generally confined to the back of the neck, though
it may also be applied to certain other parts, as the fleshy part of the thigh
or arm; but in these points issues are generally preferable.

In order to apply a seton, we require a sharp-cutting instrument to make
an opening through the integuments, and some strip which, when introduced,
may, by its irritation, keep up a suppuration from the part.    For the inser-
tion of the strip we have two instruments, Boyer's Seton-Needle and a
common straight bistoury and eyed probe.

The first consists of a flat steel blade about five inches long, six lines wide,
and perforated at one end with a hole large enough to receive the strip to
be introduced; the other end is sharp, and sloping to a point like a thumb
lancet.    To introduce the seton with this, first fasten the substance to be
used in the eye of the needle, and then seizing a portion of the integuments,
of the required width, between the forefinger and thumb of one hand, raise
it up from the parts below, and transfix its base by forcing the needle
through, and drawing it and the seton out on the opposite side to that on
which it entered, leaving the seton in the wound; after which its ends should
be fastened down by a little piece of adhesive plaster, and the whole covered
by a warm poultice, till suppuration commences, when a simple dressing is
all that is requisite.

The objections to this method are, that the seton needle is not always at
hand; that the fastening of the seton in its eye is apt to make a thick mass,
which passes through the opening with difficulty, and that it is hard to seize
the point of the needle, when wet with blood, so as to draw it through.    I
therefore prefer the straight bistoury and eyed probe, as generally resorted
to by the French surgeons.    To use this, fasten the seton by a thread to the
eyed probe; seize the integuments as before; cut them with the bistoury,

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* Electro-Physiology, by A. C. Garrat, M.D.    Boston, p. 118.

and, before removing it, introduce the point of the probe from the opposite side, and, withdrawing it and the bistoury at the same time, insert the seton in its place, as shown in Fig. 144.

Fig. 144.
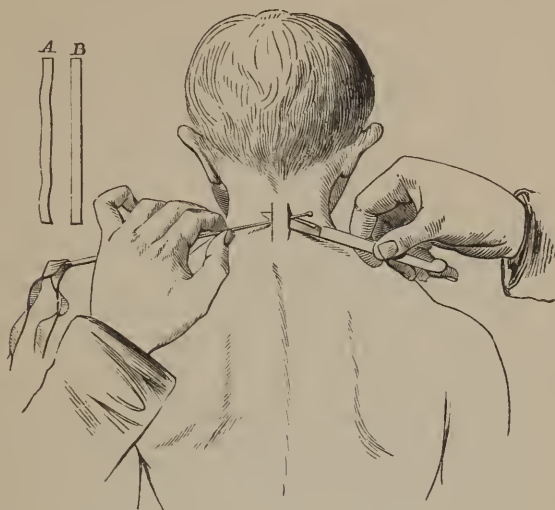


In respect to the substance of the seton there is much diversity of opinion; but let the substance be what it will, it should always be well coated with ointment prior to its introduction, and also previous to any movement of it through the wound in subsequent dressings, in order to facilitate its progress or increase its action.    For the first three days the dressing is stained by blood, or slight oozings, but afterward by pus.    When suppuration has freely commenced, the substance of the seton becomes charged with matter, which, if allowed to remain, renders it very offensive.    At each daily dressing, therefore, the seton should be drawn through the wound till this soiled part is free, when it should be cut off, and the ends fastened down and dressed as before with simple dressings; the whole being confined by a circular bandage of the neck, as at Fig. 31, or by a sling, as at Fig. 84.    As the seton by this operation is soon cut up, it will ultimately be necessary to prepare for the introduction of a new one.    This is readily accomplished by attaching it by a few stitches to the old one, anointing it well, and drawing this into its place while the old one is being removed.    A skein of saddler's silk, or a piece of silk braid, is the article most frequently employed; but where we can obtain a strip of gum-elastic, as A B, Fig. 144, or braid or tape coated with it, it will be found to be much more cleanly than the silk.

### § 2.—The General Treatment of Inflammation.

As it has been shown, when speaking of the modification of local nutritive action, called inflammation, that it is not always to be checked by the surgeon, but rather kept within proper limits, its general treatment requires that attention should be given to such physiological actions as demonstrate how the nutrition of a part is modified by the changes created in the general

nutrition of the body.    Hence the principle which should regulate the sur-
gical treatment of inflammation is, to aid the local effort by acting through
the medium of the general circulation, thus modifying the character and
amount of the liquor sanguinis attracted to the inflamed part under that
perversion of local cell action which is the starting-point of the disorder.

It having been shown that increased local "irritability" induces increased
"elective affinity" or cell action, according to the views of Addison and Vir-
chow, and that the amount of plasma acted on by the tissue cells is materially
affected by the character of the blood, the general treatment of inflamma-
tion should consist in the employment of such means as will modify both the
constituents of the blood, and the forces aiding in its circulation throughout
the affected part.    These remedies may, for the purpose of study, be pre-
sented under two distinct heads, though their employment consentaneously
is often required in practice.    The first of them may be classified under the
title of Evacuants, or articles which have for their object the elimination from
the blood of noxious or effete matters, by the agency of the secretory organs
of the body, or by the direct abstraction of a portion of the circulating fluid;
while the second, called Stimulants or Sedatives, present a class which act
by influencing the forces by which the current of the blood is propelled
through the system.

The selection of one or the other of these classes, or the employment of
both, must be mainly regulated by the judgment of the surgeon, as based
upon his observation at the moment, and especially by the forethought that
will enable him correctly to anticipate nature's efforts a few hours subse-
quently in the process of repair.    Thus, if an inflammation supervene upon
an injury in which considerable reparative effort is likely to be demanded,
too much caution cannot be exercised in husbanding the forces of the
economy, and keeping up such an exalted cell action as will augment the
local nutrition.    If, on the contrary, the development of inflammation will
so increase the tissue cell action as to induce destruction of the cells or
the destructive metamorphosis of the tissue or organ formed of them, a
diminution in the supply of blood, as well as of the force of the local
and general circulation, will be required to check its progress.    In the
inflammation supervening on gunshot wounds, the reduction of the general
powers of the system must be carefully guarded against, lest they fall below
the standard essential to proper reparative action, while in inflammation
developed by injuries in parenchymatous structures, in which there is a
large amount of connective tissue, or in those where the elements resulting
from the inflammatory action would be likely to destroy the function of the
part affected, the active employment of evacuating and alterative remedies
will often be of the first importance.    In plethoric patients, with excessive
febrile action, evacuating remedies are necessary; while in the lymphatic,
irritable or nervous temperaments, the treatment by sedatives, combined with
that of a supporting character, will be essential to success.

Premising thus the necessity of a careful consideration of the results ob-
tainable from the peculiar character of the cause developing acute inflamma-
tory action in surgical cases, and especially the necessity of attention to the
age, habits, and temperament of the patient, as well as to the reparative
efforts likely to be demanded of his vital force, the general treatment of in-
flammation may be examined under the first class, or that of **Evacuants**, as
accomplished by purgatives, emetics, diaphoretics, diuretics, and general
blood-letting; and under that of **Stimulants** and **Sedatives**, as obtained
from diet, or remedies having a special tendency to increase or diminish the
activity of the heart and arteries as well as of the nervous function.

## 1. *Evacuants.*

**1. Purgatives.**—Surgical injuries, and the inflammation that ensues, being usually met with in patients previously in good health, in whom the ordinary amount of food and drink has been taken, up to the moment of injury, purgatives may justly be regarded as the most valuable means of regulating the disorder.   Purgatives as thus employed may be resorted to either to get rid of ingesta that in most instances, from the subsequent confinement and change of habits of the patient, become marked sources of irritation, or as evacuants and means of depletion, by acting on the liver, pancreas, etc., as well as upon the mucous follicles and blood-vessels of the alimentary canal.

In most cases of inflammatory or traumatic fever, an active purge at an early period is highly useful, provided means be taken to prevent its griping, and thus causing additional irritation; and provided also, that arrangements be made for the action of the bowels, without the necessity of the patient rising from bed.   In the fever and inflammation consequent on certain injuries of the lower extremities, or in cases liable to primary or secondary hemorrhage, it would be improper, and often impossible, for the patient to rise, and, under such circumstances, the administration of purgatives would be injurious, or their utility depend on the arrangements made to give him a stool; but with this exception, purgatives may, as a general rule, be most advantageously employed in the treatment of all the acute forms of inflammation presented to the surgeon.

In the selection of one article rather than another, much will depend upon the special circumstances of the case.   To insure merely an evacuation of the contents of the lower bowel, a stimulating enema of a pint and a half of warm water, mixed with salt or soap, will suffice; while, in other instances, the entire alimentary canal should be acted on by a purgative administered by the mouth.   In this case, the administration of three compound cathartic pills of the U. S. Pharmacopœia, or a solution of the citrate of magnesia, or the compound extract of colocynth, or the compound powder of jalap, or Epsom salts or castor oil, according to circumstances, may be required.   As a general rule, the saline cathartics are most beneficial in the treatment of inflammation, where a thorough watery evacuation is demanded.   Yet, there are very many instances in which the surgeon will find it more useful to stimulate the secretion of the liver, by the administration of a full dose of a mercurial, followed, if not of itself sufficiently active, by some other cathartic.

When, however, inflammation is the result of a wounded abdominal viscus, or, when the irritation of purgation would be readily extended to adjacent parts, as after the operation of lithotomy, etc., inflammation may be better treated by some other means than purgatives.

Purgatives, to be specially beneficial as evacuants in the treatment of inflammation, should, as a general rule, be selected in view of the drain that they will induce from the intestinal mucous membrane.   When, on the contrary, a revulsive rather than evacuating effect is desired, those which gripe, as senna, rhubarb, etc., should be employed ; the contraction of the muscular coat and the vascular congestion induced being useful to distant parts, by attracting the blood to the bowels, and thus relieving the congestion of other tissues. Purgatives, as a class, constitute one of the most natural and important means of eliminating noxious matter from the blood, owing to the close connection which exists between the skin and intestinal mucous membrane. They are hence specially applicable to the external forms of inflammations, as those of the skin and areolar tissue.

Whether we admit that the fibrinous deposit of inflammation is the result of the local cell action of the tissue affected, or ensues upon an exudation from the blood-vessels, the employment of purgatives will prove advantageous. Under the first theory, they diminish the irritability and increased action of the cells of the inflamed tisssue, by transferring the irritation to the mucous membrane and excreting noxious matter; while, under the second, or the result of exudation from the blood-vessels themselves, they prove useful by increasing the exhalent action of an extended surface, thus directly eliminating from the blood elements of a hurtful character. In the latter action, they constitute a potent and valuable class of evacuants.

2. **Mercurials as evacuants.**—With the modifications of physiological doctrine, induced by the modern views of cell action and normal nutrition, there has been a corresponding modification in the opinions entertained by many able pathologists in reference to the results obtainable from the administration of mercurials. Under the influence of the ideas which regarded the presence of fibrin in inflammatory diseases as evidence of an increased amount of that which normally exists in the liquor sanguinis, and in the belief that the tendency of mercurialism or salivation was to "defibrinate the blood," or cause absorption of the fibrin "poured out" into the connective tissue, the administration of mercurials was thought to be essential to the successful treatment of inflammations in structures where its production, and the adhesions it induced, were likely to impair the function of the organ, as in iritis, in nodes, etc. Mercurials were also highly lauded as useful in promoting absorption of the products of inflammation, as seen in the affections of the serous tissues of the cavities of the body and of the joints. How this result was obtained, was not clearly explained; but that it followed their administration, was generally believed. "Recent careful observation has, however, demonstrated* that this is not so." An analysis of forty cases of pericarditis, treated with mercury, and recorded with unusual care by Dr. John Taylor, showing that only four appear even coincidentally to have been benefited in any way;† while of sixty-four cases of iritis, of every degree of severity, treated by Dr. Williams, of Boston,‡ without mercury, the results, with four exceptions, which were neglected at the commencement, were perfectly good.

If the physiological views of normal nutrition, presented by Addison and Virchow, are correct, and the elective cell action is admitted, it is difficult to understand how the administration of mercurials can have a local action in promoting absorption. When, under salivation, the excretion of the salivary glands becomes marked, and the irritation of the nervous system ensues that is characteristic of mercurialism, it is doubtful whether any impression can be made on tissue cell action of a certain and definite character. When, by irritation of the duodenal mucous membrane, there is an increased secretory action of the liver, the elimination of improper matter from the blood by this organ may become a valuable adjuvant to other evacuants, and, on the same principle, increased action of the salivary glands may prove useful as a means of excretion. But there is no evidence of the defibrination of the liquor sanguinis in salivation, nor is there good reason to regard the action of mercury as in any way a specific remedy in this condition, though such action has long been contended for by the mercurialists. While observation carefully made is creating the impression that the utility of mercurials in inflammation is, to say the least, a doubtful fact, there is good reason to admit that, as a purgative, or as a stimulant of secretory

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* Bennett, Clinical Med.                          † Op. citat.
‡ Brit. and Foreign Rev., quoted by Bennett.

organs, these articles, like other evacuants, aid in eliminating noxious matters from the blood.

3. **Emetics.**—The evacuation of the contents of the stomach, particularly in injuries happening after a full or indigestible meal, may usually be regarded as highly useful in the general treatment of inflammation. Emetics are also valuable in cases where inflammation is developed at a later period ; the act of vomiting, in some instances, being beneficial, by allaying both vascular and nervous excitement. This class of remedies is especially useful in the treatment of inflammation in free livers, provided the disorder is not the result of injury to the stomach or abdominal viscera, or connected with hernia. In inflammation consequent on injuries of the head, not attended by marked congestion of the brain, emetics may also often be advantageously resorted to, being useful not only as evacuants, but also as sedatives from the nausea induced by their use. The administration of a scruple of powdered ipecacuanha, followed by a free draught of tepid water, or two grains of tartarized antimony, either repeated in twenty minutes, if vomiting is not induced, will generally answer the purpose.

4. **Diaphoretics.**—The importance of a free secretion from the skin, in the relief of the heat of fever, as well as of inflammation, is a universally received opinion, the increase of perspiration being as useful as an evacuant, in the treatment of inflammation, as purgatives, and may most advantageously follow the administration of the latter. Any of the articles of the materia medica generally employed as diaphoretics may be resorted to for this purpose; yet, as there is usually more marked suffering and nervous irritation in traumatic than in idiopathic inflammation, such as are opiate and sedative in their action are mostly employed. Among the most valuable of these is the Pul. Opii Compos. of the Pharmacopœia, in ten-grain doses, repeated every six hours, unless a disposition to narcotism is apparent. Another most useful article is the tartarized antimony, especially in watery solution, so that a sixteenth or thirty-second part of a grain may be taken every two hours. Not only is free perspiration readily induced by this article, but the beneficial effects of the sedation of the heart's action may also be quickly obtained.

5. **Diuretics.**—Diuretics, though not so frequently resorted to as purgatives in the treatment of surgical inflammations, are yet, in some cases, especially useful, not only as evacuants, but as specially tending, by the increased flow of urine, and the diluent drinks their use necessitates, to allay local inflammation, and eliminate noxious matter from the blood. In the inflammation of the serous membranes, in those supervening on injuries in gouty constitutions, and in some forms of inflammation of the joints, diuretics are valuable additions to the means of treatment ; but, in inflammations or injury of the kidneys, ureters, or bladder, they may be injurious. Acetate of potash, nitrate of potash, wine of colchicum, bitartrate of potassa, etc., are but a few of the diuretics specially required in surgical inflammations.

6. **Of general blood-letting.**—As the earliest observers of the results of the inflammatory process attached much importance to the changes in the constituents of the blood and the action of the general circulation created by the abstraction of blood, venesection and arteriotomy soon became an established remedy in its treatment, venesection having been practiced by Podalirius as early as B.C. 1192. That the utility of a remedy thus more or less employed for so many centuries should be now doubted, and its employment positively forbidden by some, is evidence either of a change in the character of the disorders of the present century—a marked progress in physiological and pathological investigation—or the occurrence of one of those changes of professional sentiment, termed fashion, that have at various periods charac-

terized the predominating influence of the humoral, solidist, vital, or chemical
schools of pathology.

With the opinions of Cullen, Gregory, Sydenham, Rush, and Andral in
favor of its general employment, and the necessity for its use in the cure of
inflammation, and those of Louis, Skoda, and Bennett in opposition to it, it
is evident that the question is a difficult one to decide; and that in this, as
in many other questions, the special advocates of either side of the argument
have gone too far, and that the soundest and most judicious course is the
middle one, maintained by Watson and Alison, of England, and Wood, of
the United States.

Especially is this true in the treatment of inflammation as presented to
the surgeon.    In very many injuries the reparative effort of nature could
not be accomplished without that modification of normal nutritive action
designated as inflammation.    When this action is not excessive—when, in
other words, it does not proceed to the destructive or disorganized products
or metamorphosis of cell action, seen in suppuration, ulceration, sloughing,
and mortification—too much caution cannot be exercised in interfering with
a process that is in surgery often so salutary in its results.    But that the
operation of venesection can never be required in the practice of surgery,
seems a statement altogether too general to be admitted as correct.

In the treatment of wounds of the soft tissues, fractures, concussion of the
brain, etc., the abstraction of blood by venesection will, as a general rule,
be improper; while in wounds of the great organs of the chest, in congestion
of the brain, and apoplexy, the judicious employment of general blood-letting
will sometimes prove highly useful.    When we recall the fact that the direct
abstraction of a few ounces of blood diminishes the amount of the liquid
that distends the vessels of a congested part—as when syncope supervenes—
the usefulness of this remedy in regulating the development of a frank grade
of active inflammation in a plethoric patient, may be judiciously admitted.
In the same way few will deny the activity of the absorption of liquids by one
whose blood-vessels have been partially emptied by a traumatic hemorrhage;
or the increased activity of certain remedies after bleeding as compared with
their action without it; and we cannot, therefore, but admit that the loss of
blood diminishes the distention of all the blood-vessels sooner or later, as
shown by the pallor after free hemorrhage; and that while the vessels are
thus partially emptied, the veins more readily receive any liquids near them,
whether the result of previous exudation or introduced into the alimentary
canal, a notable example of which is seen in the thirst characteristic of loss
of blood.    Yet, it must be remembered that a marked degree of irritability and
increased vascular action in the arteries supervenes on the loss of blood, and
that this increased action may become the source of such irritation of cells
and vessels as will eventually terminate in inflammatory action of a destruc-
tive character.    To produce a general prostration of the powers of the cir-
culation, and thus favor the contraction of an artery and the formation of a
clot in a parenchymatous tissue, as a wounded lung, is certainly, in wounds of
the chest, the most direct mode of arresting hemorrage and saving life.    To
create temporary relaxation of the muscles by syncope will, under some
circumstances, be a useful method of favoring the reduction of a luxated
bone, or restoring a reducible or strangulated hernia—especially when other
means cannot be had.    As an operation, venesection must, therefore, be
sometimes performed, though as an important evacuant capable of control-
ling beneficially inflammatory action, its employment should doubtless be much
more restricted than was the practice some thirty years since.    By the admin-
istration of anæsthetics and antimonials, muscular relaxation can, for surgical
purposes, be, as a general rule, better obtained than by general blood-letting.

By the administration of arterial sedatives, as aconite and veratrum viride, the heart's action and the general circulation can be more continuously controlled, and with less prospect of reaction, than by blood-letting. But in the arrest of traumatic pulmonary hemorrhage, in the relief of the compression of the brain from a ruptured artery, and in the active forms of traumatic peritoneal inflammation as an adjuvant to opiates, blood-letting will often prove a valuable remedy.

When demanded, **Venesection** may be practiced either in the superficial veins at the bend of the elbow, or in the external jugular vein, or in the saphena major above the ankle, by simply puncturing the vein and favoring the flow of blood by arresting its return to the heart.

In order to make the veins at the bend of the arm prominent, apply a narrow band as a ligature a few inches above the elbow, and the five veins which usually become apparent after its application will be the Cephalic on the outer side of the arm, the Basilic on its inner margin, the Median vein in the front, and its two branches, the Median Cephalic and Median Basilic, which run from the median vein to the other two veins. The relative position of the cutaneous nerves and of the brachial artery to these veins will, it is presumed, be first learned by the student before he attempts the operation. After selecting the fullest vein, and feeling for the position of the artery, as may be told by its pulsation, let the patient grasp a stick, in order to steady his arm, while the operator seizes it with one hand, so that his left forefinger or thumb may press slightly on the vein and prevent its rolling, puncture it, and allow the blood to flow into a vessel held to receive it.

Bleeding in the Jugular vein, if desired, is to be accomplished by placing a compress over the course of the vein just above the clavicle, and fastening it in position by a bandage around this side of the neck and the opposite axilla. Then, puncturing the vein with a thumb lancet, place the edge of the bowl close against the neck, or press a bent card against the part just below the wound, so as to form a trough and carry the blood into the bowl without permitting it to trickle over the patient's clothes. After obtaining a sufficient amount, dry the wound, close it with a little piece of adhesive plaster, and then, untying the bandage, remove the compress from above the clavicle. By allowing this bandage and compress to remain in position until the wound is closed, the accidental entrance of air into the vein is prevented.

The amount of blood to be taken by any venesection for the relief of inflammation must be regulated by the circumstances of the case, and especially by the impression made on the patient's pulse. As soon as this flags, the flow of blood should be arrested.

## 2. *Stimulants and Sedatives.*

**1. Stimulants.**—By stimulants are here meant such articles as excite the action of the heart and arteries, as well as of the nervous centres, by augmenting their supply of blood; they therefore include both the arterial and nervous stimulants of therapeutists. In the ordinary forms of acute idiopathic inflammation stimulants are generally inadmissible, and the same is true of acute healthy traumatic inflammation. But there is a class of cases, usually met with in patients of debilitated habits, or those accustomed to the free use of alcoholic drinks, men who "live above par," in whom inflammation supervening on an injury can only be judiciously treated from the first by the administration of arterial stimulants, not only in the shape of tonics, as iron and quinine, but in diffusible stimulants, as found in both food and drink. In the

peculiar forms of inflammation developed by burns in intemperate persons, in traumatic gangrenous inflammation, and in that attendant on gunshot wounds and compound fractures, stimulants will often be essential to a favorable result.    When inflammation is developed in such cases, it does not, however, present the frank characters of an acute healthy inflammation, but rather the passive congestion and corresponding depression, or local paralysis of the circulation, indicative of chronic inflammation.    In many of these cases the local inflammation is rather the result of a sedative action in the local circulation, with a diminution of the general forces of the economy, than an active hyperæmia, and the administration of the usual arterial stimulants in such cases, as quinine, full diet, and alcoholic drinks, not unfrequently rouses the general powers of the system to an appreciation of the local disorder. The local sensibility being thus increased, healthy active inflammation of a truly reparative tendency is developed and the local debility overcome.    In carbuncle, erysipelas, mortification, or similar forms of recent unhealthy in- flammation, the administration of general stimulants, seconded by local stimulation, will often prove useful.    In these cases a full dose of quinine, sixteen to twenty grains, with the tinctura ferri chloridi, beef-tea and milk- punch, or brandy and water, or beef-steak and mutton-chop, with lager-beer or brown-stout, will be the best mode of relieving the local disorder.    In the class of patients met with in hospitals and alms-houses, among the intem- perate poor and those so often presented as the subjects of surgical inflam- mation, depletion often proves injurious, and stimulation salutary.

2. Sedatives.—Sedatives, and especially nervous sedatives or narcotics, are a class of remedies of great importance in the surgical treatment of in- flammation.    In that which supervenes on injury, there is most frequently such a state of high nervous excitement and irritation that the pain alone will be followed by increased arterial or febrile action, and by a local dis- turbance of the circulation that soon develops and keeps up inflammation. In these cases not only is the comfort of the patient augmented, but his general condition improved by the free use of anodynes.    After severe operations in which tissues have been freely divided, the excessive local in- flammation supervening on the effort at repair will often be controlled by a full dose of opium, or opium and ipecacuanha, thus obtaining arterial seda- tion with diaphoresis.    In the wounds of joints, in peritonitis after abdomi- nal injury, in the healing of stumps after amputations, etc., few remedies will control or even prevent the extension of inflammatory action with greater certainty than a full dose of a nervous sedative, like opium and its prepara- tions, hyoscyamus, conium, etc.    In the quick, irritable pulse, characteristic of certain wounds of the great cavities, accompanied by a hurried respiration and the other symptoms of inflammatory fever, the arterial sedatives also offer a most valuable class of remedies.

The tincture of Veratrum Viride is a remedy of this class that has lately attracted much attention.    Suggested by Dr. Osgood, of Providence, and its usefulness specially urged by Dr. Norwood, of North Carolina, its utility in the constitutional treatment of inflammation has been widely tested by the general testimony of those who have used it as to its prompt and effi- cient action as an arterial sedative, reducing the frequency as well as the volume of the pulse in a few hours.    As it is a powerful remedy, caution is necessary in its use.    Administered in the dose of three or four drops of the saturated tincture every two hours until its influence commences to be felt, then discontinued and again resumed as the pulse rises, it is a valuable remedy, and has reduced a pulse of 120 to 90 in six hours.    When this dose is too much for the patient it produces nausea, vomiting, and usually marked irritability of the stomach, followed by vertigo, faintness, cold sweat, etc.

These effects may be relieved by the administration of diffusible stimulants and opiates, and by sinapisms to the epigastric region. But if cautiously given in sirup and water, or some diluent drink, and discontinued when the heart's action is decidedly depressed, the veratrum will be found to be a most valuable addition to our general remedies for the treatment of inflammation. Fleming's, or the saturated tincture of the root of Aconite, in the dose of one or two drops in some solution, is also a powerful sedative, reducing the pulse promptly without producing the gastric irritation of the veratrum viride when continued. But as it is an active remedy, and very prostrating in its effects, its administration should be carefully watched, and its excessive sedative influence counteracted, if necessary, by alcoholic stimulants. In traumatic fever, in injuries of the joints, and in wounds of the chest and abdomen, it will be found highly useful, being more of an anodyne than the veratrum viride.

The cumulative effects noticeable in the administration of digitalis are not seen in the use of these remedies. Being more prompt and also more evanescent, they are therefore, when used with a careful and constant observation of the pulse, preferable in the treatment of inflammation. The powerful sedation of the circulation obtainable from the administration of the veratrum or aconite tinctures has induced the opinion that they might be employed instead of general blood-letting in the treatment of inflammation. Without entering on the discussion of the general question, it may suffice to say that, as the examples of inflammation brought to the notice of the surgeon are usually the result of injury and evidence of reflex nervous action, the sedative influence of these remedies is most valuable, and when combined with anodynes amply sufficient for the treatment of many inflammations, and preferable in all such as they can control for forty-eight hours.

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# CHAPTER II.

## SPECIFIC RESULTS, OR METAMORPHOSES OF INFLAMMATION.

It being admitted that inflammation, or the perverted local nutrition thus named, may induce such changes of the normal nutritive cell action as will form serum and fibrin, and that the involution of this process, or the degeneration of fibrin, develops pus, the further involution and degeneration of cell action resulting in ulceration and mortification, we may now examine the characteristics of each of these conditions.

## SECTION I.

### OF ABSCESSES.

The term **Abscess**—from *abscidere*, to separate or remove—is applied by writers to a circumscribed collection of pus in any of the tissues or organs of the body.

**Etiology.**—The proximate cause of an abscess is almost invariably a preexisting inflammation. Nevertheless, abscesses form in various parts of the

body without distinct evidence of inflammation, as well as in that peculiar morbid condition of the blood known as pyemia, in which few of the characteristics of acute inflammation can be detected during life or after death, except in connection with the veins.

**Seat.**—An abscess may occur in any of the tissues or organs of the body, though especially liable to be located in those points where there is a considerable amount of connective tissue. Wherever situated, the tendency of abscess is to the destruction of the tissues seated between it and some cutaneous, mucous, or, in rare instances, serous surface, through which it speedily discharges its contents.

**Pathology.**—In the development of an abscess the circulatory disturbance and local cell action is of greater or less extent and duration, and is followed by the formation of fibrin, which speedily coagulates, and degenerates into pus in the manner described under the head of suppuration, the change being the result of the fatty degeneration of the form-elements of the tissues involved. Formerly it was thought that the degenerated and fluid elements found in an abscess were the result of the absorption and liquefaction of the surrounding tissues; but it is now admitted that these are simply reduced to fat granules, and mingled with the inflammatory products, an explanation which seems the more probable, from the fact that elements derived from the involved textures may frequently be observed in the pus of an abscess.

It must, nevertheless, be remembered that however these liquefying and degenerating textures may contribute to the fluid contents of an abscess, the pus corpuscles here, as elsewhere, are ever to be referred to the fibrinous production, and not to the broken-down tissues. The *quantity* of texture involved in an abscess cannot be measured by any general rule, and varies not only with the extent of the abscess, but also with certain circumstances connected with the formation of the primary exudation. Thus, while on the one hand an exudation may be gradually poured out so as to embrace within its limits a considerable amount of previously normal tissue, it may on the other be formed in such quantities as to give rise to more or less tearing of the normal textures, which, being thus pressed out of the way to make room for the exudation, the abscess involves in itself comparatively little normal tissue. A familiar example of such an exudation is to be seen in the case of a blister, in which the cuticle may be separated to a considerable distance from the corium by the accumulated serum. More or less of this rending or pushing aside of textures probably occurs in all abscesses.

That this idea was a prominent one with the ancients, is perceived by referring to the derivation of the word abscess, before given; but we should err were we to ascribe the existence of the cavity in which the pus of an abscess is found, solely to this cause.

While the central part of the fibrinous production is liquefying into pus, and the involved textures are degenerating, the marginal portion of the fibrin has not yet softened from its original coagulation, or may, even if sufficient time has been permitted, be undergoing organization, thus preventing the pus of the abscess from extending injuriously, and limiting the progress of the morbid process. In inflammations in which, from the specific character of the disorder, the fibrin is incapable of organization, or even of complete coagulation, the circumscribing product is not found, and the abscess therefore spreads rapidly and involves large portions of the body, as is seen in certain cases of erysipelas and of abscesses formed during the convalescence from typhus fever.

This marginal coagulated or more or less organized portion of fibrin forming the periphery of the abscess has long been noticed and described as the *wall of the abscess.* Formerly this wall was supposed to secrete the pus,

and was hence spoken of as a pyogenic membrane; but it will be at once understood that this idea cannot at present be received in the sense originally proposed. When, however, the wall of an abscess is composed of developing tissues which have become vascular, fibrin may of course occur, from the neighborhood of these new vessels, in the same manner as from any other, and this fibrin, if not favorably circumstanced for development into tissue, will degenerate into pus, and thus add to the contents of the abscess. The mode in which the organizing walls of an abscess become vascular is identical with that in which vessels are developed in fibrinous or plastic formations generally, as has been already described. After the abscess has opened, if the circumstances under which the productions from its vascular walls are placed be favorable to the development of the fibrin, granulations form after the manner described in connection with ulcers. If, however, the circumstances be unfavorable, the abscess spreads and rapidly involves the adjacent textures.

**Varieties.**—Abscesses are of two varieties, and are known as the acute and chronic abscess.

### § 1.—Of the Acute Abscess.

In studying the progress of an **acute abscess**, it is easy to recognize the fact that it is the result of active inflammatory action; and that the three products or metamorphoses of nutrition produced by inflammation are present in it. Thus the swelling of the tissues will at first be due to the formation of serum; then to the formation of fibrin within the circumference of this

Fig. 145.
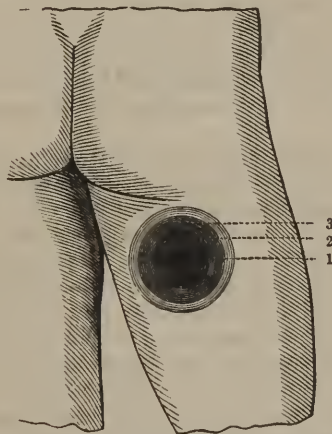


A DIAGRAM ILLUSTRATIVE OF THE CONDITION OF THE TISSUES IMMEDIATELY AROUND THE FOCUS OF INFLAMMATION WHEN ABOUT TO END IN AN ABSCESS.—1. The focus containing pus. 2. The effusion of fibrin, which limits the extension of the pus. 3. The effusion of serum outside the lymph shading off into healthy structure, and indicating the lowest grade of active inflammation.

serum; and lastly, to the formation of pus within the circumference of the fibrin. Such a condition may be readily understood from an inspection of the diagrams, Fig. 145 and Fig. 146, which also serve to explain why an abscess "points" or becomes fullest at some one point, which point is usually the centre or focus of the inflammatory action.

**Symptoms.**—The symptoms of an acute abscess may be readily understood from the preceding brief account of its progress. When inflammatory action

is about to result in suppuration, the part becomes redder, hotter, and more painful and swollen than it was before; then, as the pus forms, the constitutional symptoms become more marked—the formation of the pus, or the

Fig. 146.
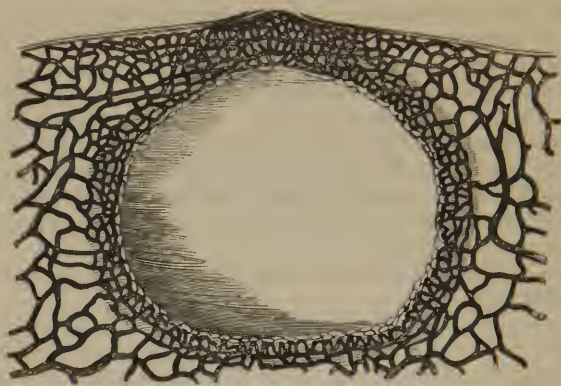
establishment of suppuration, being often indicated by a chill or rigor, and by more or less marked development of the ordinary constitutional symptoms of inflammation.    As the pus collects, the local signs of the presence of a liquid become apparent, and fluctuation may be recognized by the use of the means described under the sense of touch, page 85.

**Diagnosis.**—The presence of fluctuation being once established, and the evidences of inflammation noted, the diagnosis of an acute abscess is readily made.

**Prognosis.**—The natural tendency of every acute abscess is to evacuate itself on the side on which the tissues yield most readily, or, in other words, are most extensible and disposed to ulceration.    Hence acute abscesses nearly always discharge themselves through the skin, nature subsequently accomplishing the cure by healing the cavity through the medium of granulation and cicatrization.    The prognosis of an acute abscess is, therefore, chiefly dependent on two conditions—first, its position, that is, whether superficial or deep seated; and second, its extent.    Abscesses of the superficial tissues, as of the integuments, are more favorable in their tendency—that is, will heal more rapidly—than those situated in glands, bones, and similar structures, while small abscesses are more likely to heal than large ones, the latter creating the necessity for a greater amount of reparative material.    Abscesses in the neighborhood of important parts, as the blood-vessels, trachea, pharynx, etc., are also more dangerous than those seated elsewhere.                                                                                              •

**Treatment of Acute Abscess.**—The treatment of an acute abscess consists in the fulfillment of four indications :—

The first is to remove the general and local cause of inflammation.

The second, to encourage the relaxation of the superimposed tissues, and favor the approach of the pus to the surface of the body.

The third, to evacuate the pus so promptly as to prevent its traveling or involving other parts than those at first affected.

The fourth is to promote the contraction of the sides of the cavity, and aid the efforts of nature to fill it up.

The first indication may be fulfilled by the removal of the cause of the local inflammation, and hence is somewhat varied in its character. If the inflammatory action has been created by the entrance of a foreign body, as a splinter, ball, etc., it may, if superficial, require a division by the knife of the structures in which it is buried; after which such means must be employed as have been already stated under the general and local treatment of inflammation. But if the mechanical removal of the cause cannot be accomplished, then the means now to be recommended for the fulfillment of the second indication must be resorted to.

As a general rule, relaxation of tissue, and the tendency of an abscess to point externally, may be aided by the continued application of heat and moisture. The neatest method of doing this is by the warm water-dressing. Should poultices be deemed better, or more easily obtained, or more in accordance with the mental impressions of the patient, they may be made as described on page 98.

In connection with these means of treating an acute abscess, it should be remembered that, while heat and moisture favor the relaxation of tissue and the tendency of the pus toward the surface, *dry heat* stimulates the local circulation, augments inflammatory action, and tends to induce a contraction or thickening of tissue rather than its relaxation.

The third indication, or the speedy evacuation of an acute abscess, may be effected in one of three methods :—

I. By a simple incision with the abscess lancet or bistoury. II. By caustic, whether nitrate of silver or caustic potash. III. By means of a seton or foreign substance introduced into the cavity of the abscess.

The choice of either of these means will depend very much upon circumstances, though usually the last two are more applicable to the chronic than to the acute variety of abscesses.

As a general rule, the evacuation of the pus by a simple puncture is to be preferred in the treatment of an acute abscess, on account of the greater rapidity with which the wound heals; but there are cases in which its evacuation by this means would be improper, as in abscesses where the division of the parietes might involve important blood-vessels. Commonly, however, there is no danger of dividing vessels of importance in opening abscesses, if proper caution is exercised. Few practical errors are more frequent than those due to the timidity of young practitioners in this method of treating abscesses. Take, for instance, the suppurations beneath the palmar fascia, where the young surgeon, recollecting the normal position of the palmar arch, is afraid to incise the parts lest he should wound these vessels; or the case of bubo, where the position of the femoral vessels not unfrequently causes hesitation in the use of the knife. In these cases it should always be remembered that, as a general rule, there is but little danger of wounding vessels in evacuating the contents of an abscess, unless one proceeds with great recklessness and utter disregard of the anatomical relations of the part, plunging the knife completely *through* the abscess and penetrating its interior wall, instead of simply puncturing its external surface; for, when an abscess forms directly over an artery or vein, the skin will generally be so elevated by the distention that ensues that the distance between the surface and the vessel will be greatly increased.

In opening an abscess by puncture or by a simple incision, a bistoury, abscess lancet, or any similar instrument may be used. In evacuating its contents with either of these instruments, hold it like a pen between the finger and thumb, while with the left hand the skin at the point of incision

is made quite tense ; then plunge the instrument only deep enough to pass through the skin into the cavity of the abscess by a forward and inward motion, and an opening sufficiently large to allow a free exit for the pus will be safely made.    The subsequent flow of the contents of the abscess may be then left to nature, or its progress aided by gentle pressure and the subsequent application of heat and moisture.    Pressure may be usefully made in abscesses that are disposed to become sinuous, or that are deep seated, by binding over them, as suggested by Batchelder of New York,* a piece of compressed sponge.    This treatment has been highly satisfactory in many cases, and especially in mammary abscesses.

The general treatment of an acute abscess will, of course, vary with the stage.    Before pus is fully formed, antiphlogistic measures, as purgatives, may be necessary in order to diminish the amount of the inflammatory action; but where, after an abscess has been opened, there is a considerable flow of pus, or one which threatens to exhaust the patient's strength, the general treatment resolves itself into such means as will support the powers of the system and aid its nutrition, as full diet, chalybeates, tonics, etc., as will be explained more fully under the head of Hectic Fever.

## § 2.—Cold or Chronic Abscesses.

The **Chronic** or **Cold Abscess** resembles the acute variety only in the fact that it is a collection of pus in a circumscribed cavity, the grade of inflammation being here frequently so slight that the disorder may pass unrecognized for a long time.    Abscesses of this kind are generally due to low or chronic inflammations of the connective tissue, or to some internal disorder, and especially to diseases of the bones, or the softening of tubercular deposits in the glands, etc.    When, then, a cold abscess is seen, which the patient asserts is consequent upon a fall, blow, or other external violence, we should distrust the account, and regard the blow or fall merely as the event which first attracted the patient's attention to the complaint.    When a cold abscess supervenes upon a blow, its effects may be generally noted in the discoloration of the skin produced by the ecchymosis which followed it.

Cold abscesses may occur in any portion of the body, but are most frequently found in the neighborhood of the neck, axilla, and buttocks.    Those due to diseases of the bones, and known as lumbar or psoas abscess, being generally caused by disease of the vertebral column, will be described hereafter, in connection with the latter subject.

**Symptoms.**—The symptoms of a chronic or cold abscess are, at first, a moderate amount of vascular congestion, followed by a dull, heavy pain in the parts affected ; then, but often not before the lapse of many months, a tumor of varied size shows itself, which is hard and immovable, with a broad base, and without heat or redness.    As this augments in size, the tissues covering it are rendered thinner and softer, but do not become as red in color or as vascular as the skin over an acute abscess.    As the abscess gradually progresses toward pointing, the progress of the complaint is analogous to that described in the acute abscess, though generally very slow, the collection remaining many weeks, or even months, unchanged.    When a cold abscess is evacuated, a marked difference will also be noticed between its pus and that which escaped from the acute variety.    The pus of a cold abscess is usually imperfectly formed, is greenish, thin, and watery, ichorous in character, and frequently possessed of a strong, disagreeable odor.    It also contains floc-

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* New York Journal of Medicine, 1857.

culi, which consist of portions of the disintegrated tissue, while that of the acute variety is usually thick, "true laudable pus."

The walls of a cold abscess are also very different from those of the acute form, being indisposed to unite after the pus has been evacuated, in consequence of the absence of proper inflammatory action. These walls are also much thicker and lined by a false membrane, which, as has been before stated, is designated as a Pyogenic membrane—a name, however, not correctly applicable to it, because it is not capable of secreting pus, but is merely a cyst, formed of the surrounding connective tissues bound together by fibrin, and covered over by a layer of dead granulation cells or corpuscles—the pus being formed by the degeneration of the fibrin which is developed upon the surface of the sac or of the so-called membrane.

Treatment.—When, as is often the case, the amount of pus in a cold abscess is large, it may, if its contents are evacuated at once, give rise to a set of symptoms of a typhoid character. A cold abscess should not, therefore, be entirely emptied at any one period, but should be discharged carefully and by degrees, the possibility of the entrance of atmospheric air into its cavity being well guarded against. As the action of the atmosphere in the cavity of a cold abscess is often most dangerous to life, it requires special consideration.

Of the Entrance of Air into a Cold Abscess.—When air finds an entrance into the cavity of a cold abscess, a change is sometimes perceived in the odor given off by its pus, the latter becoming extremely offensive. It will also be noticed that it becomes acrid and irritating, while a train of constitutional symptoms may be observed similar to those produced by the formation of pus in the blood, as in pyemia, dissecting wounds, etc. The peculiar action of the air upon the abscess is due to a chemical change by which a hydrosulphate of ammonia is formed. This substance being once absorbed into the general circulation lowers the vital powers, prevents the coagulability of the blood, and produces a condition of things much resembling that seen in typhus fever. The hydrosulphate of ammonia here formed has been proved to be present in the circulation by various tests; thus it has been found in the blood itself, as well as in the various secretions of the body, and especially in that from the kidneys, salivary glands, etc.

The efforts of nature to overcome the depression consequent on this state of affairs produces a condition of the patient's system which is known under the name of *hectic fever*, and will be the subject of the next section.

Treatment.—In considering the treatment of cold abscesses it must be noted that they require both local and constitutional measures.

The Local Treatment differs from that which would be proper in a case of acute abscess, especially in the fact that the puncture of the tissues and the evacuation of the pus should be delayed as long as possible, cold abscesses often continuing for months without making any progress; but when it becomes necessary to evacuate their contents—as when the extreme distention and tenuity of the skin shows that by longer delay the abscess will open itself by the natural process of ulceration through its parietes—it is generally better to anticipate the event by means of an operation. When the pus has been removed by any of the means hereafter detailed, the surgeon should at once press the sides of the cavity together, so as to bring its walls in contact, apply compresses and bandages to support them in this position, and then carry out a general invigorating plan of treatment.

When the evacuation of the contents of a cold abscess is decided on, various means may be employed in order to accomplish it. An excellent method consists in making a valvular opening through the skin with a bistoury, by pushing the instrument horizontally some little distance under the skin before

entering the parietes of the abscess. By this plan its walls can be readily opened at a point remote from the orifice, in consequence of which the pus will escape through the skin, after being compelled to travel gradually along the canal thus formed without there being any probability of the admission of air. When as much of the pus is evacuated as is deemed desirable for the first period, pressure upon the course of the canal will prevent the entrance of air until the opening in the integuments can be closed by adhesive plaster.

Another very good plan of evacuating the contents of a cold abscess is that of Bonnet, of Lyons. It consists in placing the limb, or the patient, if necessary, in a bath of tepid water, making a valvular opening, as just stated, and then forcing out the pus so as to allow it to mingle with the water. Of course, under these circumstances, the entrance of air is impossible, the entrance of the water into the cavity of the abscess being prevented by the outward flow of the pus. In a very large abscess, one-third or one-half its contents may be evacuated at a time, and this is usually sufficient; the opening and the walls of the cyst being subsequently supported by a compress and bandage.

The modification of Schuh's instrument for Paracentesis Thoracis, suggested* by Metcalf, of New York, or the suction pump and exploring canula recommended† for the same operation by Wyman, of Cambridge, might also be advantageously employed for the evacuation of large cold abscesses without permitting the entrance of air.

Should the air enter the cavity of the abscess in spite of these precautions, and the consequent typhoid symptoms be developed, the abscess should at once be freely laid open, so as to permit the pus to have an easy exit; after which its cavity should be thoroughly washed out by injecting some solution calculated to neutralize the putrefactive process, which would otherwise ensue. A very good wash for this purpose may be made by adding one ounce of liq. sodæ chlorinat. to six fluidounces of water. This may be used three times a day or oftener, a proper invigorating constitutional treatment being persevered in at the same time. Neither of these modes of evacuating cold abscesses should, however, be employed until it is evident that the abscess will rupture and evacuate itself if let alone, as it often happens that these cases do very well and disappear by the efforts of nature when unevacuated; provided the strength of the patient is properly supported, and no active local measures adopted.

Besides the methods just described, the contents of a cold abscess may be evacuated by means of *caustic*—a plan of treatment which has been recommended for the evacuation of cavities containing serum, as hydrocele, etc., as well as for cavities containing pus. In employing caustic for the evacuation of cold abscesses, the nitrate of silver or caustic potash should be rubbed upon the spot where the opening is desired to be made. If nitrate of silver is used it must be moistened, but caustic potash being deliquescent, does not require any more moisture than it can obtain from the air, or from the tissues with which it is brought in contact. Caustic potash, when thus applied, forms a sort of soap with the disintegrated tissue, and creates a slough which soon separates by the powers of nature, and leaves an aperture in the integuments through which the pus is readily evacuated.

Nor are instances wanting in which the *seton* also has advantages, as in those where the evacuation of the pus is intended to be slowly accomplished. In order to employ it in such cases a few strands of silk should be placed in a sail-maker's needle, and passed through the cavity of the abscess, or in a probe, after the abscess has been transfixed by a sharp-pointed bistoury;

when the probe should be passed and the silk permitted to remain. The capillary action thus established through the strands of silk will gradually empty the abscess of its contents, while the presence of the foreign body in its cavity will excite a sufficient degree of inflammation to promote the union of the two surfaces when their contact is permitted by the evacuation of the pus. The needle or bistoury which punctures the walls of the abscess should always be passed from above downward, and this precaution should be strictly observed, because if first introduced at the lowest point, the pus will escape before the entrance of the seton is completed, and the walls of the cavity be rendered flaccid.

It cannot, however, be too strongly impressed upon the mind of an inexperienced surgeon that hectic fever, or the typhoid condition just alluded to, does not often show itself until the pus of a cold abscess is discharged through the skin; and that the greater the delay in the evacuation of such abscesses, the better for the patient.

## SECTION II.

### OF HECTIC FEVER.

In the remarks upon the constitutional symptoms of inflammation, it was stated that, after the development of a certain amount of local inflammatory action, with its accompanying functional disorder of the local cells and bloodvessels, an impression was produced upon the brain, and thence transmitted to the circulation, which resulted in a rigor, fever, and sweat, with the other evidences of that condition of the system which was designated as inflammatory, symptomatic, or sympathetic fever. (See page 207.) This fever, as there stated, lasted for a period which varied from twenty-four hours to several days, and then passed off with certain changes in both the local and general symptoms.

In cases of inflammation which result in a free secretion of pus, especially if this secretion is long continued, or in cases of injury in debilitated constitutions, where the powers of the system are not equal to the reparative effort demanded of them, a somewhat similar train of febrile symptoms is developed, differing, however, from that termed inflammatory fever, in the fact of its being more permanent; that it presents decided periods of remission; that the paroxysm returns at intervals of greater or less regularity, and that it is accompanied by great exhaustion and emaciation.

This febrile condition has been designated as "Hectic Fever," either from the exhaustion which it induces, (εκτηκω, to exhaust,) or from its long duration, (εκτικος, habitual,) rendering it apparently habitual with the patient.

Hectic fever presents, in most instances, decided evidences of its belonging to the remittent type of fevers, a distinct exacerbation being evident toward night, or immediately after meals.

The development of hectic fever is so insidious that it is liable to be overlooked, and hence it is that the experienced surgeon so constantly advises the younger members of the profession to "watch carefully the commencement of hectic," for, if it is not observed, it will take a firm hold upon the system, and, unless checked, terminate in death.

**Symptoms.**—The symptoms of hectic are as follows: After the continuance of a free drain upon the system for a few days, or perhaps longer, the patient complains of chilliness, which is often *so slight* as to pass unnoticed. This is generally followed, as in other cases of fever, by a reaction, which results in a greater or less degree of febrile excitement, the

pulse becoming merely a little quickened; the next day it may be still more so, and then the day after be yet more accelerated, and count 130. The skin now becomes hot and dry, especially in the palms of the hands and the soles of the feet, while at the same time the whole face is flushed, or "the cheeks alone present a moderate, circumscribed blush, pleasing to look at," but indicative of serious disorder in the system.

After this febrile state has lasted for one or more hours, the patient awakes from an uneasy sleep, in the middle of the night, or toward four o'clock in the morning, and finds himself bathed in a profuse perspiration, which, from its recurrence and the debility which it induces, is designated as "colliqua-tive," (*colliquescere*, to liquefy.) Under this perspiration the skin now becomes sodden, has a clammy, sticky feeling, and is unpleasant to the touch; so much so that after feeling it the surgeon is immediately disposed to wipe his hands. As the disease progresses, the fever and sweat appear earlier in the day, the latter becomes more and more profuse, and diarrhœa, also of a colliquative character, often supervenes, the patient seeming to melt away in his own secretions.

In the early stages of hectic fever, the remission is frequently tolerably distinct; but by-and-by it is less marked, and a certain degree of febrile action, with an irritable, accelerated pulse and hot burning skin, is kept up throughout the whole day. Under these circumstances the *pulse* does not continue hard, tense, and full, as it is in inflammatory fever, but becomes quick and frequent, counting often from 110 to 150 beats per minute.

In connection with this condition, it may be well to mention to the young student the difference between the states indicated by these two terms, *frequent* and *quick,* as applied to the pulse, whether in surgical or medical disorders, as a pulse may be quick yet not frequent, or may even be both quick and slow, which is to be thus explained : In a quick pulse the im-pression made upon the finger is very sudden and of short duration, after which there may be quite a pause before the next beat is felt; while in the frequent pulse the artery makes many more beats in a minute, though its impression is less rapid, the interval between each beat being very slight. A pulse that is quick and slow is one beating 60 in a minute, but in which the *impression* is momentary, and the *interval* between the two beats quite marked.

The appetite in hectic is sometimes inordinate, sometimes unnatural, and sometimes after having been inordinate returns to a natural condition. The thirst is generally considerable, but usually not so great as it is in inflam-matory fever. The tongue, which in the early stages is often clean or slightly furred, is sometimes disposed, toward the last, to become dry and covered with an aphthous ulceration. The condition of the bowels may at first be healthy; but generally, after the disease has continued for some time, a diarrhœa sets in, which adds to the debility already produced by the colliquative sweats. After hectic fever has existed for a short time, its presence is shown by the rapid *emaciation* which ensues, the fat almost en-tirely disappearing. Besides the emaciation, there is a class of minor symp-toms which now show themselves, and are the result of the want of a proper degree of nutrition. Thus the skin presents a certain loss of vitality, which is evinced by its throwing off its epithelial scales, these being shown in the dust seen in removing the patient's stockings; or sometimes noticed in quantities in the bed on turning down the bedclothes. The hairs, too, par-ticularly the finer ones, are disposed to fall out, their connections being loosened by the loss of vitality in the skin. The same is the case with the other appendages of the skin, the vitality of the nails being lessened, and a disposition shown in them to curve in at their extremities. Hence this

in-curving of the nails is regarded by many as a positive sign of consumption, or rather of that condition of consumption in which hectic fever is present.

At the same time the pearly white color of the conjunctiva shows the impoverished state of the blood.   The eyeball is generally sunken, and the bones of the cheeks are prominent, from the removal of the accumulation of fat just below the malar bone; while all over the body the bones stand prominently forth, and, by making undue pressure upon the skin, produce congestion, inflammation, and that peculiar variety of a slough called the "bed-sore."

Throughout the entire course of hectic fever, the brain and nerves, and especially the mind, preserve their activity, the patient being generally cheerful, and "seeming to gather rays of hope from the very clouds of death which are settling round him."

**Etiology.**—Concerning the etiology of hectic fever there is a diversity of sentiment.   At one time it was thought that the introduction of pus into the blood was the source of this fever, but now there are good reasons for doubting this, among which may be stated the fact, which has been already alluded to, that the pus corpuscle cannot by itself pass through the coats of the blood-vessels.   The absorption of pus, or its passage from without into the blood-vessels, except where there is a breach in the continuity of the vessel, is therefore a fact which may very reasonably be doubted.   When pus is found in the blood it should be looked upon as due either to the fact just mentioned, that a vessel is open at some point in the neighborhood of the suppuration, or that the pus has been formed in consequence of some inflammation in the vessel itself.   This doctrine of the production of hectic fever by the absorption of pus is, therefore, one which is not now generally regarded as tenable.

The most plausible theory is that which assigns the cause of hectic fever to the nervous irritation consequent on the efforts of nature to furnish an amount of material equal to that which has been lost, the augmented irritability of the tissue cells being transmitted to the brain; and this theory is supported by the fact that if we can check the discharge, or remove the diseased tissue, as by amputation of a limb, the symptoms of hectic disappear.   This is so frequently seen, in the amputations performed for the relief of the exhausting suppurations which ensue on diseases or injuries of the joints, as to have become an aphorism.   The relief experienced in these cases is often so complete and immediate, that the night after the operation is frequently the first since the injury during which the patient enjoys a sound night's rest.   If hectic fever were due to the introduction of pus into the blood, this would not be seen, for, as the poisoning of the blood would then continue, no relief from it could be gained by the removal of a limb. On the other hand, if hectic fever is due to nervous irritation, it may be readily understood how it would cease when the cause of the irritation was removed.

With regard to the impossibility of the absorption of pus, it has been objected that large abscesses frequently disappear, their purulent contents being certainly removed by absorption.   But it must be remembered that in this case the pus is not absorbed as pus, but that it is only the liquid portions of the accumulation that are thus taken up; after which, the pus cell being broken down, either becomes disintegrated, and goes to the formation of a new structure which closes the cavity, or becomes incorporated in lymph, and forms an indefinite substance.

**Diagnosis.**—With regard to the diagnosis of hectic fever from intermittent, the complaint with which it is most liable to be confounded, there can

be no difficulty, the history of the case, in the majority of instances, being sufficient to point out the difference between the two. Intermittent fever is of miasmatic origin; hectic supervenes on exhaustion and irritation; while the cases will be very limited in which a patient who has an extensive suppuration or injury will also have been exposed to such a source of miasm as could create intermittent. Intermittent fever, moreover, offers a regular paroxysm; there is a distinct chill, followed by fever and perspiration, and then there is an interval in which the patient is very nearly or quite well; but in hectic, after it has continued for any length of time, there is seldom a full remission, more or less febrile action being generally found throughout the day. But that which will guide with most certainty in the diagnosis is the fact that hectic fever, considered surgically, is generally conjoined with some external source of irritation, or some drain calculated to exhaust the patient's strength; and this fact, by pointing out the cause of the disease, will prove of the greatest value in deciding on the proper treatment.

**Prognosis.**—With regard to the prognosis of hectic, much will depend upon the cause and upon the extent to which it has drawn upon the patient's strength. If he is advanced in years he will be more apt to succumb, other circumstances being equal, than when in the full vigor of life. His social position should also have its effect upon the surgeon's prognosis, patients in hospitals, who are cut off from fresh air, and surrounded by the fetor of disease, having less prospect of recovery than those more favorably located.

**Treatment.**—The indications to be followed in the treatment of hectic fever are: First, to remove the cause of the irritation; second, to support the patient's strength.

To carry out the first of these indications it is necessary that the means should be varied to suit the case. It is therefore impossible to lay down any particular rules, the course pursued in any case being chiefly directed by the nature of the cause and the possibility of its removal.

In fulfilling the second indication, those means should be employed which have been already pointed out as calculated to restore the patient's strength, and to support a system which has been exhausted by the causes which have produced the fever. With this object, a full, free, generous diet, chalybeates, etc., should be directed. Beef-steak and porter will be found to answer an excellent purpose, and with them may be combined doses of quinine carried to the extent of producing sedation, while opiates should be so administered as to aid the quinine in checking that nervous irritation which often keeps up the disease.

The success of this plan of treatment is another argument in favor of the doctrine that hectic fever is due to nervous derangement. If hectic were due, as some of the other fevers are, to an altered condition of the blood, we might anticipate some benefit from evacuating remedies; but experience has shown that the more the patient is depressed by depletion, the more aggravated will be the symptoms of the fever.

## SECTION III.

### OF PYEMIA.

In a preceding page it was stated that there was no reason to suppose that the absorption of pus and its admixture with the blood could be the cause of hectic fever. There is, however, a disease called **Pyemia**, which presents febrile symptoms, together with a formidable series of constitutional disturbances that are generally ascribed to such an admixture.

Repeating the assertion then made concerning the impossibility of the absorption of pus into the blood through the coats of the vessels, there is yet no reason to deny its effects when there placed, even though rarely noticed, and it may therefore now be said that the presence of pus in the blood undoubtedly occurs in pyemia, and that it is due either to some one of the modes then pointed out, such as a rupture of the coats of a vessel while in contact with a suppurating surface, or to a collection of pus, from an inflammation within the vessel itself, and more particularly to that form of disease known as suppurative phlebitis.

Symptoms.—The symptoms of pyemia, or the blood poisoning resulting from the presence of pus in the circulation, are as follows : after the existence for a short period of a suppuration, in which, from an opening in some vessel, pus has entered the blood ; or especially when an inflammation of the lining membrane of a vein has led to its production within the vessel, a well-marked, heavy chill is noted, differing greatly from that of hectic, if in nothing else at least in its greater violence. During this chill there are frequently well-marked signs of cerebral disturbance, as, for instance, incoherent mutterings, or low delirium, and the pulse becomes small and thready; while the face assumes a peculiar leaden hue, the extremities are blue and cold, and the skin contracted. After some twenty minutes or more, this chill passes off, the warmth returns, and a degree of febrile action is set up which is proportioned to the extent of the previous depression. In the course of an hour, however, there is usually an imperfect recurrence of the chill, followed by fever, and so on throughout the day slight erratic chills recur, while, at the same time, the surface appears to all but the patient to be quite as warm or warmer than it is during health.

If there is a wound, and it be examined under these circumstances, its appearance will be found to be much changed as the granulations are now pale or livid, and lose the florid color which was due to a proper circulation of blood. The pus also changes in character, and, instead of presenting the cream-like appearance of ordinary healthy pus, is evidently dry and unhealthy, much resembling that which has been pointed out as *sordes*. The patient soon becomes exhausted, and from want of nerve force sinks into a sort of stupor, which is not unlike that of typhus fever. The respiration shares in the general disorder of the system, being not unfrequently rapid and labored, counting sometimes as many as fifty inspirations in a minute, whereas, during health, it is not more than fifteen or eighteen. If the chest is examined by auscultation, subcrepitant râles will also be noted; and if we examine the skin, it will be found more sodden, earthy, and lead colored than it was in hectic; while the joints swell and are painful, more especially those of the lower extremities; and there is frequent pain in the calves of the legs. The tongue is dry, and frequently fissured ; sordes collect on the teeth, the pulse becomes faint and tremulous, the belly swells, the cornea dim and hazy, and death soon closes the scene.

Other symptoms frequently precede a fatal result in this, as in other complaints ; thus, the sphincters become relaxed, the urine and feces are passed involuntarily, and the patient is unable to maintain his position in bed, tending constantly to slip down toward the foot of the bedstead, etc.

If a post-mortem examination be made, metastatic abscesses will often be found in all parts of the body, but especially in the lungs, liver, spleen, kidneys, muscular fibres, or in the cellular tissue, the whole system seeming to be infiltrated with pus.

This disease, though of frequent occurrence in the surgical hospitals of Europe, is not common in the United States, and therefore merely requires this brief allusion.

**Treatment.**—In the treatment of pyemia, no fixed plan can be laid down as calculated to benefit the patient, the blood being frequently so thoroughly poisoned as to render recovery, under any circumstances, extremely doubtful. Cauterization of an open suppurating surface, with the internal use of alcoholic stimulants, and of such means as will preserve the action of the heart until the poison can be eliminated, are all that have been suggested as likely to prove useful.

## SECTION IV.

### OF ULCERATION AND ULCERS.

It has been shown, in connection with the formation of pus and the production of abscesses, that a degeneration of the products of inflammation, and of the tissues affected by it, rapidly follows when inflammatory action attains a certain degree of intensity. This degeneration or loss of vitality being most apt to result in a sore or ulcer, the process which forms it is designated as "ulceration," and as this process develops an "ulcer," ulceration and ulcers are not only naturally associated with each other, but are sometimes loosely described as identical. There is, however, this difference, that an ulcer cannot be formed until the process of ulceration has previously existed; the one (ulceration) being the cause, the other (the ulcer) the effect. They may, therefore, be advantageously studied under different heads.

### § 1.—Of Ulceration.

The term **Ulceration** is employed to express that vital action by which a solution of continuity is created in any of the structures of the body, but especially in those known as the soft tissues.

The opinions advanced by physiologists at various periods respecting the process of ulceration, and the removal by it of certain portions of the body, have been very varied, being generally based on the prevailing doctrines of the day respecting the vascular system, and the natural growth and decay of all tissues. Galen appears to have regarded ulceration as a process of *erosion*, or as a solution of continuity due to the solvent power of the liquids of the body. Cuvier and those of his period supposed that the elementary particles of the body were in a state of perpetual change, and that absorbent vessels were unceasingly employed in removing the old, while the arteries as unceasingly deposited new material, a want of action in the arteries permitting the absorbents to take up more than their due share, thus creating a deficiency or chasm in the structures involved in the action. From the latter opinion came the doctrine of the existence of two sets of vessels, those depositing material being regarded as "exhalants," while those removing it were called the "absorbents."

As late as the time of Hunter, ulceration was regarded as indicative of the overaction of these "absorbent vessels," and it was not until the development of the powers of the microscope that more recent writers, as Paget[*] and Miller,[†] brought forward the cell doctrine of the present day. These writers, in common with Bennett, Virchow, and the best pathologists of our period, look upon ulceration as evidence of the "molecular death of a part,"

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[*] Lect. on Surg. Pathol. by Paget, p. 270, Philada. edit., 1854.
[†] Miller's Principles, by Sargent, Philada. edit., 1853.

the latter being expressive of the opinions established by the observations of microscopists in regard to the minute structure of the tissues, as well as of the mode of normal nutrition. A brief examination of these views will prove instructive, as exhibiting the opinions of two different periods of the science of surgery.

According to the views of Hunter, ulceration was the consequence of "excessive action in the absorbents." This doctrine was based upon the generally-received idea just mentioned, that there existed in the system two sets of vessels acting in antagonism to each other: the one, the "exhalants," being constantly engaged in throwing out new structure; while the other, the "absorbents," were as constantly employed in removing that which already existed, and was supported by Hunter's experiments upon the bones of a growing animal, in which the deposit and absorption of the coloring matter given as food to a young pig was positively shown. According to this theory, the normal state of the system was preserved only as long as a balance of power existed between these vessels; but so soon as this was destroyed, and one set acted more powerfully than the other, disease, either in the form of hypertrophy or atrophy, ensued. If the exhalants acted most powerfully, various tumors were the result; but if the overaction was in the absorbents, atrophy, or the process of ulceration, rapidly occurred.

The views of more modern authors, or those of the last thirty years, with Bennett, Paget, and Miller at their head, agree, on the other hand, in assigning the process of ulceration to "molecular death," or to the death of the cells of the part affected, the vitality of each part being due to the activity of the nutritive and preservative action of the component cells of the tissues. According to this theory, ulceration is established as follows :—

Inflammatory action being developed, is followed by congestion of the vessels of the part, and this congestion, by impairing the supply of blood, impairs the nutrition of its cells. When the inflammatory action goes as far as suppuration, and the vitality of the structure is so much diminished that the cells die, and are removed faster than they are reproduced by the organization of the lymph that is effused, a deficiency of structure results, to which the name of ulcer has been applied, while the process is called **ulceration**. In the development of ulceration, the lymph or exudation corpuscles, which had previously been effused, *degenerate*, from two causes : first, from an imperfect circulation in the part affected ; and secondly, from the fact that they are softened, or disintegrated by contact with the pus already formed, thus creating a semifluid mass that gives evidence of fatty degeneration and the liquefaction or moistening and breaking down of tissue cells that characterize it. It is, therefore, easily perceived that the process of ulceration, under this view of the subject, can never take place in a healthy tissue, and that the parts must first be diseased or inflamed to a greater or less extent, before ulceration is established.

According to Virchow, ulceration is preceded by changes in the tissue about to ulcerate, identical with the changes that result in the formation of lymph and pus. For example, in the skin the connective tissue corpuscles swell up, their nuclei multiply, and pus corpuscles are thus produced, as before explained ; the epithelium and the most superficial layers may resist the process for awhile, but soon are burst by the accumulated pus, or softened into a diffluent mass ; a small ulcer is thus formed, which spreads by a similar process, the subjacent connective corpuscles multiplying into pus corpuscles as before, while the matrix or intercellular substance liquefies, just as in the formation of an abscess, thus setting the pus corpuscles free to be thrown off from the surface. The old idea that an ulcer was formed by the eroding action of the pus is therefore erroneous, the pus of a healthy ulcer being

perfectly bland. The spreading of the ulcer is due to a continuation in the surrounding tissue of the process by which it was originally formed.*

Ulceration, when once established, is extended first by the molecular death of the tissue immediately surrounding the primary ulceration; and secondly, by the detachment and casting off of the cells thus destroyed, their removal being favored by the pus which accompanies the ulcerative action. An examination of any rapidly spreading or sloughing ulcer, where the structure is destroyed faster than it can be removed, will readily show this process, the dead matter which there accumulates being left directly before the eye of the observer as a mass, which has been specially designated a "*slough*."

According to Paget,† there is usually "in the beginning of the process of ulceration, the detachment of a slough or portion of dead tissue by the removal of the layer of living tissue that bounded it; the spreading of an ulcer, independent of such a visible sloughing being effected by the inflamed tissues that form its boundaries degenerating, and being detached in minute particles or molecules, or being decomposed and dissolved in the fluid discharges which accompany the process."

Ulceration, according to this author,‡ presents four different periods. In the first, there is congestion and inflammation; in the second, the cells of the affected part, from compression, impaired circulation, or other causes, lose their vitality; in the third, they are detached by liquefaction, by shrinking, and by the swelling of adjacent parts; and in the fourth, they are separated either by degrees, as pus, or in a mass, as a slough.

Fig. 147 illustrates the conditions just described; the dead mass 1 is seen



Fig. 147.
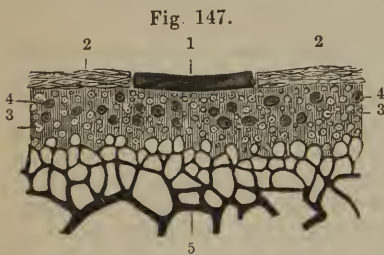
separating from the surrounding healthy tissues 2 2; beneath it lymph corpuscles 3 are seen mixed with pus cells 4, and below, in the diagram, the congested vessels 5 may be seen lying beneath the layer of lymph by which nature closes them while attempting to check the progress of the ulcerative action. When ulceration ceases, this layer of lymph becomes the source of the granulations, through the medium of which the reparative process is effected in the manner that will be detailed under the head of Wounds.

Ulceration may be noted in nearly all the tissues of the body, though the removal of articular cartilages does not present the same conditions as are noted in more vascular structures. The bony tissues also modify to some extent the course noted in the soft parts, as will be again alluded to in connection with the diseases of the bones.

Of the soft tissues, the skin and areolar tissue are the most liable to ulceration, the tendons, ligaments, blood-vessels and nerves resisting this destructive action in a marked degree.

### § 2.—Ulcers.

The chasm in the tissues created by the ulcerative process constitutes the condition designated as an **ulcer** or sore.

Ulcers have been variously defined, some of the definitions being, how-

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* Die Cellular Pathologie, pp. 406–7, 1854.
† Lectures on Surg. Pathol., p. 273.                    ‡ Op. citat.

ever, equally applicable to the condition of parts seen in the efforts of nature to repair wounds.    Thus, an ulcer was defined by Sir A. Cooper* "as a granulating surface, secreting matter;" while other writers allude to it "as a solution of continuity in any of the soft tissues of the body, attended with a secretion of pus, or some other kind of discharge."† The definition which best accords with the views of surgeons at the present time is that of Chaussier, to wit: "that an ulcer is a solution of continuity in any of the soft or hard tissues, produced by a general or local cause, and accompanied by a discharge of pus, ichor, or sanies." The frequent occurrence of ulcers, and the inconvenience experienced by those who suffer from them—many of whom being of the laboring classes can illy afford to lose the time often required in their cure—should induce the surgical student to give close attention to their consideration, the healing of an ulcer often demanding the exercise of the highest degree of surgical skill, and requiring for its basis a full and correct knowledge of the details of the process of inflammation.

In the efforts of surgical writers to render this subject plain and simple, there has, however, occasionally been exhibited a degree of minuteness that has rather tended to the confusion of the student, each variation in the condition of an ulcer being spoken of as if it constituted a distinct class, or was due to a special vital action.

The opinions of Mr. Hunter and those who preceded him in regard to the overaction of the absorbents in developing ulcers, as alluded to under ulcerations, have also left such an impression on the public mind that, though in a great measure thrown aside by the profession, it yet exercises an influence on those out of it, the common notion of "drawing salves" being necessary to cure an ulcer being impressed as household words upon all from their most tender years.   Hence the use of stimulants, as Turlington's balsam, etc., yet so popular with the old women who profess to cure sores of every kind in all sections of the country.

As an example of the varieties made by writers in their classification of ulcers, may be cited that of Sir Everard Home,‡ who offers no less than six different varieties :—

1st. Ulcers in parts which had sufficient strength to enable them spontaneously to recover.

2d. Ulcers in parts which were too weak to allow recovery to take place.

3d. Ulcers in parts whose actions were too violent to form healthy granulations, whether arising from the state of the part or the state of the constitution.

4th. Ulcers in parts whose actions were too indolent to carry on healthy action.

5th. Ulcers in parts which had acquired specific action.

6th. Ulcers in parts which were prevented from healing by a varicose condition of superficial veins.

Even Mr. Miller,§ who is so favorably known in the United States for his excellent treatises on surgical subjects, makes the following widely-extended classification of ulcers :—

1. The Simple Purulent, or Healthy Sore.   2. The Weak.   3. The Scrofulous.   4. The Cachectic.   5. The Indolent.   6. The Irritable.   7. The Inflamed.   8. The Sloughing.   9. The Phagadenic.   10. The Sloughing Phagedena.

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Now as the process of ulceration exhibits only one stage in the progress of inflammation, and as granulation and cicatrization also constitute portions of the grand process by which nature repairs all solutions of continuity, a much more simple classification of ulcers would be that which would accord with the varieties of inflammation, as Acute and Chronic, or Healthy and Unhealthy Ulcers, to which might be added the Specific Ulcer.   Under the first class, or the acute or healthy ulcers, I would therefore place all those whose natural tendency is to heal, or in which there might be noted the ordinary processes of healthy inflammation.   In the second, or the unhealthy class, I would group all those whose tendency is to spread, or whose progress corresponds with the ordinary steps of unhealthy or chronic inflammatory action.   This class would embrace the irritable, sloughing, phagedenic, and indolent ulcers of other writers.   In the third might be grouped all such as are dependent on or modified by a specific cause, as the cancerous, syphilitic, scrofulous, varicose, etc.   In studying ulcers more in detail, we may, therefore, first examine the characters of the first class, or those designated as the acute or healthy ulcers.

1. Of the Acute or Healthy Ulcer.—Ulcers of the acute or healthy class are sometimes alluded to as "the simple sore."   The edges of this ulcer are characterized by their smooth, even, and unindented character, resembling in this respect the ordinary condition of a wound which has been made with a knife in a healthy structure, the skin up to the very margin of the sore retaining most of its natural characteristics, and not presenting signs of inflammatory swelling.   When in the healthy ulcer the process of cicatrization has commenced, these edges also often exhibit little processes, or extensions of cuticle over the granulations immediately within them.   The granulations are of a bright, clear, red color, smooth, shining, and covered more or less by "true laudable pus."   They are also somewhat conical or pointed in their shapes, do not rise above the level of the adjacent surface, and do not bleed unless roughly touched.   The discharge is a cream-like pus of a whitish-yellow color, which may be readily wiped off the skin adjacent to the sore, so as to leave no trace of its presence—that is, it is unirritating to the skin. It is neither acid nor alkaline, is inodorous, and, when examined under the microscope, presents true pus globules floating in the liquid matters.   The seat of this ulcer may be in any portion of the body, and the patients who labor under it are usually the young and middle aged, who possess good constitutions.

The causes of the healthy ulcer are varied, consisting of anything that will establish healthy inflammation and the ulcerative process in a good constitution.

Treatment.—The treatment of this ulcer is generally very simple, the natural tendency of the sore being to heal by the process of granulation and cicatrization.   All that is necessary, therefore, is for the dresser to avoid officious interference with the process of nature; thus, in cleansing the sore, let him abstain from washing the pus from off the granulations, though he may thoroughly cleanse the skin adjacent to them.   Let him also, when the ulcer is so situated as to be kept in constant motion by the action of the part, resort to such means as will insure rest, as a splint, or confinement to bed, or the use of a sling, etc., or the approximation of the edges by adhesive plaster.   In order to favor the organization of the lymph, and the formation of granulations, it will generally prove useful to maintain a certain degree of heat and moisture by protecting the surface of the sore from the action of the atmosphere by the use of the warm water-dressing, or by means of lint spread with *fresh* simple cerate, or calamine ointment, or mucilage.   These articles may be advantageously fastened on the limb by means

of a handkerchief folded like a cravat, and then carried obliquely around the part, as in Fig. 128, p. 165.

Formerly heat and moisture were very generally applied to ulcers by means of poultices made of various substances, some of which were medicinally useful as stimulants, but the majority mere recipients of moisture and heat. When the application of heat and moisture is desired, the warm water-dressing just alluded to will prove the most useful, the decomposition and rancidity created by the chemical changes in the substance of many poultices rendering them rather a source of irritation than of relief.    Instances in which the adjacent sound skin has exhibited evidences of Eczema S mplex and Eczema Rubrum after the application of the poultice, are sufficiently common, and it will therefore be found most useful to substitute, as far as possible, the warm water-dressing; the addition of opiates or astringents to the water making this dressing far superior to the old one of poultices. When in the treatment of the acute or healthy ulcer the reparative process begins to flag—that is, when the granulations become paler, the pus less thick, and the cicatrization does not evidently advance—it will prove useful to stimulate the surface by touching the margin of the sore very lightly with the stick of the nitrate of silver, so as to form a white deposit, and this stimulus may be repeated every twenty-four or forty-eight hours, until the reparative action again advances.    It is also sometimes useful to paint the granulations near the edges of the ulcer with a camel's-hair pencil, wet with a solution of nitrate of silver, five or ten grains to the ounce of water, or to pour over it a solution of sulphate of zinc of the same strength.    In some cases the application of a piece of lint, moistened with the zinc solution, and lightly bandaged with a handkerchief, will prove serviceable by keeping the action up to the proper point for the organization of the effused lymph, from which the process of cicatrization results.    Throughout the treatment of this ulcer, attention should be given to the state of the digestive organs, so as to guard against constipation, as well as to the amount and character of the food, lest it prove too much for the powers of the system, and develop irritation.

2. Of the Unhealthy or Chronic Ulcers.—Under this class I would group all ulcers in which may be traced the ordinary evidences of unhealthy or chronic inflammatory action—that is, ulcers in which the color, heat, pain, and swelling are highly developed, as well as those in which one or more of these signs of inflammation are deficient, or only present in a modified degree.

Of those in which the heat, pain, and swelling are marked symptoms, we have the "Irritable," the "Sloughing," and the "Phagedenic," as well as the "Fungous" ulcers of the older surgeons, while the "Indolent" variety exhibits all the evidences of chronic inflammatory action, with the failure of the reparative process of acute inflammation to heal the chasm developed by the original source of the ulceration.

In the class of unhealthy or chronic ulcers, I therefore place two varieties, the one being marked by *excessive* inflammatory action, the other by a *deficiency* of vital force.

1st. ULCERS DUE TO ACTIVE UNHEALTHY INFLAMMATION, or those known as the Irritable and Sloughing ulcers, present marked characteristics, which will readily enable the observer to distinguish them from those of the acute and healthy class.

The edges of the skin near the Irritable Ulcer are usually shining, red, hot, painful, and swollen, giving evidence of high inflammatory action, while the margin is serrated, indented, undermined, or irregularly destroyed in consequence of the burrowing of the pus, and the absence of the layer of lymph

which checks the destructive process in healthy inflammation, Fig. 148. The granulations are either very deficient, owing to the degeneration of the lymph layer which forms their basis, or give evidence of over-action, being of a deep-red color, raised above the level of the skin, spongy, very painful, and bleeding on the slightest touch, or even simply from the dependent position of the part, or the action of the neighboring muscles.

Fig. 148.



The *pus*, or rather *ichor*, from this variety of ulcers is thin, acrid, and irritating, of a pinkish yellow from the admixture of blood, or of a light brown, like pus, blood, and water when mixed together. Wherever the discharge remains, it is disposed to evaporate, and form crusts or scabs, sometimes drying in patches on the surface of the sore. In this will be found, under the microscope, traces of imperfect cells mixed with granules and fibres of the structure involved.

Seat.—The irritable ulcer is chiefly seen on the leg above the ankle, or between it and the knee. The whole adjacent structures, particularly when the ulcer is on the leg, are heated and swollen, and the pain, especially at night, is very severe and burning, the patient being restless, feverish, and exhibiting the other constitutional evidences of inflammation.

The *patient* is most commonly one of irregular habits, a high liver, or drunkard, or of a cachectic or bad constitution, and with an especial derangement of the digestive organs. The *causes* are varied. Sometimes a healthy ulcer degenerates in consequence of a want of attention to the sore; errors of diet; too much exercise, or the frequent application of sources of irritation, as repeated blows, friction of the part by clothing, etc. In the intemperate, or those with disordered digestion, a scratch of the skin will sometimes suffice to establish the irritable ulcer, the tendency of which is constantly to spread. When its tendency is to slough, and the edges lose their vitality rapidly, it constitutes the variety known as the "Phagedenic Sore," this being a higher or more marked grade of the "Sloughing Ulcer."

Treatment.—As this class of unhealthy ulcers presents evidence of excessive inflammatory action in the part, in consequence of which the reparative material degenerates more or less rapidly instead of continuing to be productive in its tendency, the indications in their treatment are—first, to allay the local irritability and vascular action; and second, to improve the general condition of the patient's system.

Local Treatment.—As the local irritation causes the patient considerable suffering, attention must be first given to the dressing, and this should generally be of the mildest possible character.

Few articles are better adapted to the unhealthy and irritable ulcer, as a primary dressing, than that of warm water, applied as before directed; the patient being placed in bed, and the limb elevated so as to drain the blood from it and diminish the local congestion. Should the pain be very marked, it will prove useful to add ℨj of the extract of opium to a half pint of the warm water, and renew it by wetting the lint in this solution every hour or two, the solution being kept warm by placing it in a vessel of hot

water, or by means of a spirit-lamp underneath the cup which holds it. Sometimes, and especially when the whole limb is swollen and painful, lint wet with cold anodyne water, so as to envelop it entirely, or the dressing by irrigation, (page 100,) affords the greatest relief.

When the unhealthy or irritable ulcer takes on the sloughing or phagedenic character, its progress may be arrested by the application of lint wet with very dilute nitric acid, of the strength of one drop of the officinal acid to the ounce of water, or fifty drops to the quart, as advised by Sir Astley Cooper; a piece of oiled silk being placed over the lint, and the dressing retained by a turn or two of a roller, or of a light handkerchief, these ulcers being often very intolerant of pressure.

Cooper's anodyne wash is also sometimes very useful in this class of sores. It is composed as follows :—

> R.—Ext. opii, ℨij ;
> Pul. gum. acac. ℨij ;
> Aquæ calcis, fℨij :
> Aquæ fontan. fℨiv.

When the ulcer has lost its irritability, and is disposed to take on the characters of a healthy sore, moderately stimulating applications will often prove useful, as the Aromatic Wine of the French Hospitals, viz. :—

> R.—Menthæ piperitæ,
> Origani vulgaris,
> Rosmarinus officinalis,
> Salviæ officinalis,
> Thymus vulgaris,
> Flores lavandula vera, āā ℨij ;
> Vini rubri, (claret,) Oij.
> Mix, and let it stand 15 days.

This, diluted with water, in the proportion of half and half, the proportion being increased or diminished according to its stimulating effects, as shown by the patient's sensibility, will often prove highly serviceable. The healing of this ulcer after it has ceased to be irritable will often be expedited by the application of lint soaked in mucilage, as that of flaxseed, gum-arabic, or pith of sassafras ; ointments, even when prepared with care and apparently free from rancidity, having a marked tendency to irritate this class of ulcers, the heat of the body soon tending to the production of oleic and margaric acids, and thus stimulating the parts to a renewal of the unhealthy condition.

**Constitutional Treatment.**—From the very first visit and local application the surgeon must, however, remember the importance, in the treatment of this as well as every other ulcer, of giving attention to the condition of the patient's general health, and especially to his digestive organs. When he presents a heavily furred tongue, with a yellow and bloated skin, and exhibits other evidences of hepatic disorder, nothing is better than an emetic of ℈j or ℨss of powdered ipecacuanha, followed, after the nausea has passed away, by a purge of calomel and jalap, each grs. x; or nine grains of blue mass given at night, and followed by a saline cathartic the next morning After freely evacuating the alimentary canal, diaphoretics and sedatives often prove useful, and may be continued for several days, or until the pain, sleeplessness, and irritability have passed off. A good prescription, that may be continued for two or three days after free purging, is as follows :—

> R.—Pul. Doveri, ℨj ;
> Hydrargyri chlorid. mitis grs. x ;
> Syr. q. s. M. et ft. pil. xx.
> S. Take one pill every four hours.

The additional dose of ten grains of Dover's powder at bedtime is also sometimes necessary to secure sleep. The action of opiates and diaphoretics having been already explained in connection with the constitutional treatment of inflammation, it is unnecessary to do more at present than state, that throughout the entire course of this class of ulcers the general treatment of inflammation is essential to their cure; but blood-letting, either locally or generally, is badly borne by those who suffer from the irritable ulcer.

2d. INDOLENT ULCERS.—When the process of repair has been arrested in the simple healthy ulcer, or in one of the irritable, sloughing, or phagedenic class, the sore may heal to a certain point and then remain unhealed for a period which may vary from thirty days to as many years. Hence this kind of sore is often designated as the chronic or indolent ulcer, and is the second species of the unhealthy class.

The indolent ulcer constitutes the greatest number of the ulcers found in the laboring classes, among soldiers and sailors, as well as in the wards of hospitals and almshouses.

Its causes are neglect of the simple sore, repeated attacks of ulceration, constant exposure to irritating agents, or the cessation of active inflammatory action in the irritable sore.

Its seat is most commonly on the lower portion of the leg just above the ankle, especially toward the malleoli, and in preference the inner one, its seat on this side being probably influenced to some extent by the position of the great saphena vein.

Fig 149.
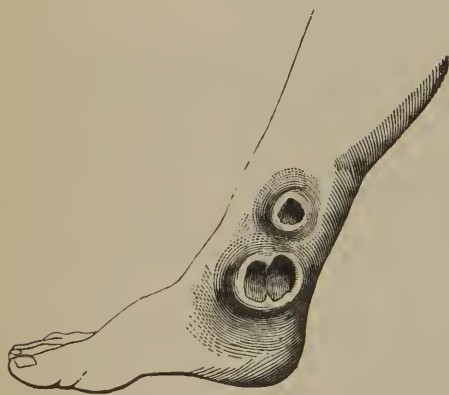


Its edges are elevated, protuberant, rounded, smooth, and often whiter than the adjacent skin; while the surface of the sore looks as if much deeper than usual, though in reality nearly on the level of the adjacent skin, the apparent depth being due to the elevation of its margins, Fig. 149.

The granulations are so badly developed that they are often not recognizable, the surface being formed of a gray, pultaceous-looking structure; or if distinct granulations are visible, they are pale, flabby, and jelly-like, do not bleed even when somewhat roughly touched, and are often so insensible as to sustain for an instant, without feeling it, the direct contact of a hot iron. This insensibility is, however, sometimes due to a crust of dirt which has collected on their surfaces. When the granulations of the indolent ulcer are very exuberant, and rise above the skin, they constitute the "fungoid ulcer" of some authors.

The pus is viscid, gluey, thick, or muco-purulent, disposed to dry and form thick, hard scabs, and is often very deficient, the amount of the discharge being trifling. The odor of the indolent sore is peculiarly offensive and permanent, a room being often scented for hours after a visit from one of these old sore legs.

The limb often gives evidence of long-continued irritation, is swollen, and has the skin apparently hypertrophied; the veins are often also more or less enlarged and varicose; and the skin immediately around the sore, as well as

in other points where former ulcers have existed, is livid, mottled, brown, or dark red, being not unfrequently affected by chronic Eczema Rubrum.

The **pain** is trifling, the chief inconvenience being the enlarged, heavy state of the limb.    The general health is fair, or such as is usually seen in the laboring classes, especially if *moderate* drinkers.

**Treatment.**—From an examination of the characters of the Indolent or Chronic Ulcer, it is evident that the reparative process consequent on the first production of ulceration in the part has been arrested; hence the thickened, everted edges which show the efforts of nature to check the progress of the disorder by the effusion of lymph, and hence the flabby granulations and permanently-congested capillaries—the formation of the granulations proving that the primary condition of healthy inflammatory action had existed.

The indications in the treatment are, therefore, to get rid of these useless materials, and excite active healthy inflammation, so that a new reparative substance may be produced in the part.    The means of fulfilling the first indication, or the removal of the useless materials, are varied; thus the thickened edges may be pared away with the knife, or absorbed by nature under pressure, or the vascular action excited in them and in the granulations by stimulants, as by pouring on the sore hot beeswax and turpentine, as advised by Stafford, the two being mixed and applied as hereafter stated.

In paring off the callous edges of the indolent ulcer, it is necessary to apply the scalpel flatwise to the limb, and, starting from the sound side on a line with the sound skin, shave off all that intervenes between this point and the sore.    The hemorrhage which ensues is trifling, as the thickened edges removed in this manner possess but little vascularity.    The surface of the sore being then covered with dry lint, as a stimulant, or painted with the nitrate of silver, a new inflammatory action will be set up, and the part take on more of the character of the simple, healthy ulcer, and require to be treated on the general principles of inflammation.

A better plan for removing the edges, and stimulating the surface of this sore, is, however, to be found in the application of pressure.    The advantages of pressure in the treatment of indolent or callous ulcers appears to have been suggested by Wiseman, who was surgeon to Charles II. of England in 1762, and who recommended the use of the laced stocking for this purpose.    Whately, in 1799, revived this practice, covering the sore with a plaster composed as follows :—

> ℞.—Emplast. plumbi, ℥iv;
>         Aceti, f℥j;
>         Axungiæ porcinæ, ℥xij.
>     M. et ft. ungt.
> S.  To be spread evenly on kid,

and then applying very accurately a soft flannel bandage previously well shrunken by washing it in very hot water.    In several instances this treatment has proved in my hands an excellent dressing.

Baynton, about the same period, also treated ulcers by approximating their edges by means of strips of adhesive plaster, covering them with compresses, and then bandaging the limb from the toes to the knee, wetting the bandages each morning while on the limb, with cold water, so as to promote evaporation from the limb.

These plans, with some trifling modifications, are the means most employed at the present time—a combination of all of them being often the best method of treatment.    When, for example, an indolent ulcer of two or more years' standing enters a hospital, the treatment should be as follows :—

Apply at night a hot poultice of powdered white-oak bark; have the limb thoroughly washed and shaved next morning; and then, as advised by Stafford, mix four parts of beeswax and one of Venice turpentine, melt them together by a moderate heat, and, when it is on the point of cooling, cleanse and dry the ulcer by wiping its surface with dry lint; dip a brush into the wax, and drop it on the sore, so that the whole excavation may be filled with it, or pour it from the vessel into the ulcer until it covers the edges as a cake. After the wax has become solid, fasten it in its place by a strip or two of adhesive plaster. On the third day this dressing may be renewed, and, if granulations have appeared, it may be reapplied; or the limb, after its cleansing, may be dressed as follows, as advised by Mr. Crichet :—

Fig. 150.



Cut a number of strips of adhesive plaster about a half inch wide and long enough to extend a little over two-thirds of the circumference of the limb. Then, warming a strip by holding it on a can of *boiling* water, commence an inch or two below the ulcer by fastening one end to one side of the leg, and, drawing firmly on the strip, cause it to pass around and adhere to the limb. Then apply a new strip, so that it will cover about one-third of the preceding strip, and continue to apply strips until they reach at least an inch above the upper edge of the ulcer, fastening the ends by a vertical strip so as to prevent the ends curling up, Fig. 150. Over this apply the spiral bandage of the lower extremity, and let the dressing remain for three days, the patient using the limb moderately in the mean time. On the third day remove the bandage, and, if the plaster is yet firm, cleanse its outer surface of the pus, which often escapes through the strips, by wiping it carefully with a damp sponge, and reapply the bandage as before. On the sixth or ninth day the plaster should be removed and the surface thoroughly cleansed, when the ulcer will generally show a marked improvement; the dressing may then be renewed as before, until the sore assumes more of the characters of the healthy ulcer, when it should be treated accordingly.

Pressure, under these circumstances, often acts most admirably, causing the removal of the lymph which formed the thickened edge of the ulcer, and stimulating the circulation in the part to the production of granulations.

Pressure as applied by means of the bandage may be resorted to, when desired, by means of the spiral of the extremity. (See p. 112.)

Dr. Brainard, of Chicago, recommends the vapor of iodine as highly satisfactory in the treatment of indolent ulcer, as clearly disinfectant and favoring cicatrization. It is applied as follows: "Dress the ulcer with cerate spread on lint; then fold from one to four grains of iodine, according to the size of the ulcer, in several layers of lint, and place it on the spread cerate; cover this with oiled silk and tin foil, the latter extending beyond the edges of the ulcer, securing the whole with a bandage. The warmth of the limb soon vaporizes the iodine, and a sensation of heat is felt. If too much iodine is applied, it will act as an escharotic."*

**Treatment of Fetid Ulcers, etc.**—MM. Cornè and Demeaux have suggested a mixture of plaster and coal tar in the proportion of one to two, three, or even more parts of coal tar to one hundred of calcined plaster.

* Chicago Journal, Jan. 1860.

This combination is spread, in a pulverized state, over the surface of fetid ulcers, or incorporated into a liniment or ointment with oil or lard.

It may also be used for wounds in an offensive condition in cases of mortification, etc., and has been recommended by M. Velpeau, of Paris, and by M. Cuveiller, physician-in-chief to the French hospitals in Milan during the Italian campaign of 1859.*

Permanganate of potash in solution has been recommended by Girdwood, of London, in 1857, as a useful stimulant or escharotic, and disinfectant in the treatment of ulcers, especially cancers of the penis and uterus, which are especially fetid. Twenty grains in a pint of water may be used as a wash to the uterus, and ten to twenty grains to the ounce as a slight escharotic in exuberant granulations. When moistened in a saucer and left in a ward, this salt also acts as a disinfectant, though, in my experience, not so well as the chloride of lime.

"Elkoplasty, (ελκος, ulcer, and πλασσω,) or Old Ulcers treated by Anaplasty." Dr. F. H. Hamilton, under this title, has published *two cases* treated by this operation with considerable success, and lays down the following summary with regard to elkoplasty:—

"1st. Ulcers, accompanied with extensive loss of integument, do generally refuse to heal, whatever may be the health of the body or the limb.

"2d. Anaplasty will sometimes succeed in accomplishing a permanent cure, and especially where the health of the body and of the limb is perfect, and where, by inference, the refusal to heal is alone attributable to the extent of the tegumentary loss.

"3d. The graft must be brought from a part quite remote—generally from an opposite limb or from another person.

"4th. If smaller than the chasm which it is intended to fill, the graft will grow, or project from itself new skin to supply the deficiency.

"5th. It is not improbable that the graft will expand during the process of cicatrization at its margins, but especially for a time after the cicatrization is consummated.

"6th. In consequence of one or both of these two latter circumstances, it will not be necessary to make the graft so large as the deficiency it is intended to supply."†

The originality of the suggestion of this method of treating ulcers has been a subject of some discussion, Dr. John Watson, of New York, claiming priority in the application of anaplasty to the treatment of ulcers, and giving the details of two cases operated on successfully by himself—one in April and one in July, 1844, Dr. Hamilton's first operation dating in 1846. Dr. Watson prefers employing the skin of adjacent parts to carrying the new flap from a distance.‡

In reply, Dr. Hamilton claims that his operation is altogether different from Dr. Watson's; that the essential points of diversity are the *obtaining the flap from a distant part*, and the *small size of the graft employed*, which is not intended to cover the whole ulcer, but to "establish a new centre or focus of cicatrization"

Ordinary anaplasty, without these peculiarities, has been applied to the treatment of ulcers by M. Velpeau.

"The application of anaplasty to the treatment of ulcers or granulating surfaces is, however, as old as anaplasty itself."§

* Maryland and Virginia Medical Journal, Jan. 1860.
† New York Jour. of Med., vol. xiii., N. S., p. 187, 1854.
‡ Ibid., p. 339, 1854.
§ Ibid., vol. xiv., N. S., p. 86, 1855.

Dr. F. D. Lente publishes a case in which elkoplasty was successfully applied (February, 1855) to the treatment of an ulcer the size of a dime on the outer side of the leg of a man sixty-eight years old.*

How far any operation can be required for the relief of ulcers, can only be decided by each one at the moment, though there can be no doubt that these operations must prove rare exceptions to the general plan of healing ulcers by the treatment before described.

### § 3.—Specific Ulcers.

Under the head of **Specific Ulcers** may be placed all such as are due to special causes, as the Varicose Ulcers, or those induced and kept up by a varicose condition of the veins; the Toe-Nail Ulcer, as well as those due to constitutional disorders, as Scrofula, Cancer, and Syphilis. As the consideration of the latter will be reserved for the detailed account of the disorders which originate them, we shall examine first the peculiar characteristics of those due to varicose veins.

### I.—VARICOSE ULCERS.

**Varicose Ulcers** may present the characteristics either of the Irritable or of the Indolent species; the obstruction of the capillary circulation, caused by the enlarged veins, resulting in either of the conditions of tissue alluded to under each of these varieties of ulcers. Most frequently, however, Varicose Ulcers present all the signs of the Indolent Ulcer. In either case they require no other treatment than that already advised for the relief of this class of ulcers, except that such a degree of pressure as will afford support to the veins, or otherwise diminish their calibre—as by the constant use of a laced stocking—is essential to the permanency of their cure. The treatment required for the enlarged veins by which this class of ulcers are developed, will be given hereafter, in connection with the disorders of these vessels.

### II.—THE TOE-NAIL ULCER.

The **Toe-Nail Ulcer** is a form of the irritable ulcer, which is found on the inner, and sometimes also on the outer side of the flesh adjoining the nail of the great toe, Fig. 151. This ulcer is the result of inflammatory action, developed in the part either by the great toe being compressed against the second toe by a narrow and short boot, or by a stocking which is too short in the foot, or by "stumping the toe," or it sometimes follows the receipt of blows, or heavy weights upon the top of the toe. In consequence of the inflammation developed by any of these causes the skin swells and rises over the side or end of the nail, the latter thus appearing to be buried in or "to grow into the flesh." This, however, is seldom the case, the origin of the ulcer from the incurving of the nail being rare, as compared with the uprising of the skin consequent on the development of inflammation.

Fig. 151.

When the inflammatory action distends the soft tissues, the continuance of the irritation soon produces an abrasion or bursting of the cuticle, which rapidly creates an ulcer of the inflamed and irritable variety, this being accompanied by considerable suffering as compared with its size, owing to the continued irritation of the edge of the nail. Sometimes the inflammation travels around the nail and involves its matrix, so as to produce a form of onychia, and sometimes exuberant granulations surround one or more sides of the nail, according to the extent of the ulceration. When the inflammation reaches the bone, caries and the destruction of the phalanx of the toe, similar to that seen in the whitlow of the fingers, are very apt to ensue.

**Diagnosis.**—The seat and history of the disease render its diagnosis easy.

**Prognosis.**—The prognosis should be guarded, as a cure without the removal of the nail is somewhat uncertain, and it is unpleasant to a surgeon to find his opinion of such an apparently trifling complaint proved to be incorrect by the return of the disorder.

**Treatment.**—The indication in the treatment of the toe-nail ulcer is to remove the cause, and this may be accomplished either by a palliative and temporary plan, or by one that will thoroughly eradicate the disorder.

The *palliative treatment* consists in directing the patient to wear a loose and very square-toed shoe, so as to prevent the great toe from being pressed against the second by the lateral pressure of the boot, or to wear stockings or boots which are not so short as to force up the end of the toe against the nail. When a tendency to inflammation of the skin becomes apparent, and irritation is induced, relief may be had by soaking the foot in warm water, scraping the top of the nail tolerably thin, and then lightly packing a little charpie or soft thread under the edge of the nail, so as to elevate it above the sore, as advised by Fabricius; or by placing a very small compress over the swollen flesh, and fastening it down by a little strip of adhesive plaster carried around the toe and over the side, so as to force the flesh off the nail, as advised by Dr. Meigs, of Philadelphia. At the same time the irritability of the ulcer, especially if accompanied by exuberant granulations, may be relieved by touching it lightly with the nitrate of silver every forty-eight hours, or by keeping a piece of lint spread with Turner's cerate on the ulcer before applying the compress, or by powdering it every day or two with arsenious acid, which is then to be covered with a compress of lint. As the nail grows in length it should be but lightly trimmed, and that only at the end, caution being given to prevent the patient from trimming it at its corners.

The *radical cure* of this disorder can best be accomplished by the removal of the nail, an operation which was formerly one of the most painful in surgery, but which may now be performed without the consciousness of the patient, as follows: After creating perfect anæsthesia, by causing him to inhale one part of chloroform, well mixed with three of ether—each by weight—run one blade of a pair of sharp-pointed scissors under the nail from its point to the base, so as to divide it in the middle. Then pass a spatula or scalpel handle around the fold of the skin at the root of the nail, and, seizing the two halves in a pair of forceps, turn them out. After checking the slight bleeding by the pressure of a piece of lint, pass a sharp-pointed stick of caustic potassa entirely around and within the matrix, so as to thoroughly cauterize the surface from which the nail grows, and introduce with a probe a morsel of lint into the matrix, so as to prevent its closing up. Then cover the whole toe with the warm water-dressing, and let the patient be roused from the anæsthetic state by such means as will stimulate his brain. The water-dressing should now be continued until free suppuration is estab-

lished, care being taken throughout the first week to keep the matrix from closing up, or contracting adhesions with the surface which was below the nail. Subsequently dress the sore as a simple ulcer, and in about three weeks it will be healed, and the patient radically cured. Without the sepa- ration of the fold of the skin from the nail previous to the evulsion of the latter, and unless the cauterization of the matrix after the evulsion of the nail be thoroughly done, a new nail will be liable to reproduce the disorder. The tender state of the toe for some weeks subsequently will require a loose boot, and the absence of all pressure on the top or sides of the toe.

In the Boston *Medical and Surgical Journal* for December, 1859, Dr. N. Gilman proposes a simple and immediate cure for this excru- ciatingly painful affection, by cauterizing the part with hot tallow. The patient on whom he first tried it was a young lady, who had been unable to put on a shoe for several months, and was a case of long standing. To relieve it he put a very small piece of tallow in a spoon and heated it over a lamp till very hot, and then put a few drops on the granulations. The effect was almost magical. Pain and tenderness were at once relieved, and in a few days the granulations were all gone, the diseased parts dry and destitute of feeling, and the edge of the nail exposed so as to admit of its being pared away without any inconvenience. The cure was complete, and the trouble has never returned. The plan, he says, has since repeatedly been tried and never failed to cure.

M. Wahn recommends stuffing between the edge of the nail and the ulcer the powdered perchloride of iron. This at first augments the sensibility, but in fifteen minutes destroys all pain, rendering the diseased parts in twenty- four hours as hard as wood. Vienna paste, carefully applied, has also proved useful.

### § 4.—Of the Sequelae of Ulcers.

Ulcers having been shown to be the result of inflammatory action, and their reparation due to the organization of lymph through the process of granulation and cicatrization, (as will be again alluded to in connection with wounds,) it might be thought that a thorough cure could, in most in- stances, be readily and certainly obtained. Experience, however, proves the reverse, and that an ulcer once established is very liable to heal up to a cer- tain point and then have its progress arrested, or, if healed, to open again at or near the original seat of the complaint. The cause of much of this difficulty may, it is thought, be made apparent by a brief allusion to the state of the parts seen in many limbs anterior to, during, and after the occurrence of an ulcer.

One of the most common causes of the arrest of the reparative or healing process in many ulcers is the neglect of rest, or of the employment of such means as will prevent the stretching of the newly-formed skin, such, for ex- ample, as that which ensues on muscular action in the part. When the tender character of the newly-formed skin and the vessels beneath it is recalled, it must be evident that this newly-formed tissue cannot sustain much tension without giving way, and that even a slight rupture or crack in it will be sufficient to develop enough inflammation to start anew the ulcer- ative action. Hence the importance of quiet as obtained by the use of splints, rest in bed, etc., as well as by the use of strips of adhesive plaster applied over the cicatrix and then carried partly around the limb, or at least on to the adjacent sound skin, so as to support the recently-formed cicatrx. In a certain class of cases, as the indolent ulcers, motion in the part has been shown to be sometimes useful, and to aid the reparative process; but

it only does so by exciting the very action in the indolent structures which is so injurious in those which are more delicate and newly formed.    Attention to the condition of the newly-formed skin for a few weeks is then essential to the preservation of its soundness in a limb which has been ulcerated.

Another point demanding attention is the tendency of the congestion of tissue left by the healing of an ulcer, and constantly seen during its existence, to result in an effusion of serum beneath the cuticle, and the production of Eczema Rubrum, or the pustules of Impetigo, Ecthyma, or even of Rupia.

These affections of the skin, even when consequent on ulcers, have been so long regarded in the United States as peculiarly appropriate to treatises on Dermatology, that it is rare to find even an allusion to them in works which are purely surgical.    As they are of very common occurrence, and frequently the origin of ulcers, as well as a great obstacle to their cure, they deserve the special consideration of every one investigating this subject, being as truly surgical complaints as the ulcers with which they are sometimes more or less directly connected.

**Eczema Simplex** is a vesicular complaint of the skin, which shows itself frequently upon the legs, either in consequence of vascular congestion or repeated though slight irritations; or as the result of the application of poultices or their long-continued use in the treatment of ulcers.

**Symptoms.**—Soon after the application of any irritant, the patient complains of itching, heat, and fullness of the part; the skin becomes of a bright-red color, which is more or less diffused, and sometimes occupies the entire front of the leg for an extent of four or six inches.    When closely examined, minute *vesicles*, or small and fine blistered points, may be seen, of about the size of a pin's head, seated directly in the inflamed skin.    These vesicles, being soon ruptured, leave the skin moistened, or as if varnished, and, by exposing the true skin to the action of the atmosphere, increase the burning and itching which previously existed.    As the serum of the discharge dries, it forms thin, white scales on the skin, which are similar in appearance to those created by a dried solution of gum-arabic or starch, and give to the whole surface of the part a white, scaly, and cracked appearance.    A continuance of the disorder, leading to new vesicles and increased flow of serum, soon thickens these scales and makes them more brownish, though they continue soft and comparatively thin—that is, not so thick as the scab seen in a dried vaccine pustule.    If this acute attack passes off, the skin is left covered with a delicate cuticle, which wrinkles superficially on motion, and is accompanied by a dark-red color of the tissues below it, which ultimately becomes brown, and leaves the peculiar discoloration so often seen after the healing of any ulcer.

**Eczema Rubrum.**—When eczema simplex has existed for a few days, and developed deep redness, it is designated as Eczema Rubrum—a condition that is common in connection with the indolent as well as the irritable variety of ulcers.    When eczema rubrum affects several inches of the limb, and the latter becomes slightly swollen under its irritation, it is not unfrequently spoken of as " Chronic Erysipelas," though very much misnamed, erysipelas generally producing large bullæ or blebs, and not the fine vesicles of eczema.

When this condition has lasted a few weeks, it is called **Chronic Eczema Rubrum,** and leaves the skin cracked, excoriated, and presenting a red, soft, swollen surface, which continues for months.    This is one of the most frequent sequela of ulcers.    Sometimes chronic eczema rubrum results in scales of considerable thickness, which have been mistaken for Psoriasis inveterata, from which it may be told by picking off the scales and carefully examining the part—a moist surface or a few vesicles being always found in eczema

underneath the scales, while psoriasis does not at any period of its course give evidence of the presence of moisture.

**Treatment.**—The indications in the treatment of Eczema Rubrum are the same as those given under the constitutional treatment of Inflammation, viz.: purging, cooling drinks, mild diet, and the removal of all sources of irritation. When connected with ulcers, it will generally yield to the use of a foot bath, night and morning, of warm water slightly thickened with wheat bran, or to the application of mucilages; or, if there is much discharge and excoriation, to the anointing of the surface, or the application of linen spread with the following ointment :—

> ℞.—Hydrarg. chloride mit. ʒj;
>       Pul. plumbi acet. grs. vj;
>       Axungiæ, ℥ss.
> M. et ft. Unguentum;

attention being given, at the same time, to the substitution of the warm water-dressing for all poultices. In the irritable ulcers, and in patients with marked disorder of the digestive organs, or in those much annoyed by the itching, (in consequence of which the skin is irritated by scratching,) the administration of the liquor potassæ in the dose of 15 drops, increased to 30 or 50, three times a day, and given in a little sweetened water, will prove highly useful.

**Impetigo Figurata.**—This cutaneous disorder is also often seen on the legs, either as preceding or following the development of ulcers.

**Symptoms.**—Impetigo figurata appears in the form of slightly raised red patches, which are soon covered by small pustules, which, by becoming confluent, originate ulcers. These pustules differ in their results from the vesicles of eczema, being soon covered by thick, greenish-yellow scabs, the skin around them becoming much thickened in consequence of the inflammatory action which accompanies their development.

**Treatment.**—Impetigo figurata requires the application of the warm water-dressing, or, if the scabs do not readily separate, the addition of the carb. sodæ in the proportion of grs. xij or xv to the ounce of water, or the soda may be applied as an ointment in the same proportion to the ounce of unguentum aquæ rosæ, though the wash is preferable when the discharge is free and the surface of the skin remains superficially ulcerated. After the removal of the scabs, the application of a wash of acetate of lead or sulphate of zinc, in the proportion of 6 or 12 grains to the ounce, will sometimes be necessary.

**Ecthyma** and **Rupia.**—The pustules of Ecthyma and Rupia are not so common in connection with the presence of ulcers as eczema and impetigo, though they are frequently the starting-point of the ulceration. Being both due to inflammatory action, general principles suffice for the direction of their treatment.

**Summary.**—In summing up the consideration of the treatment of ulcers, it will now be seen that the origin, duration, and cure of these very troublesome, and often chronic, surgical disorders, require that the surgeon should examine carefully the condition of the parts, both in the ulcer and in the surrounding tissues; that he should subdue or excite the inflammatory action until he brings it to that degree which is essential to the formation and organization of the lymph or plasma, which is the origin of tissues generally; and that, while the reparative process is proceeding, he should guard the patient from any source of local or constitutional derangement which can interrupt it. The best test of a proper degree of inflammatory action, as connected with the healing of ulcers, is the presence of healthy granulations.

If the granulations are pale and flabby, stimulate them ; if not sufficiently formed, favor the circulation through the part by heat and moisture ; and when new skin is forming, or the cicatrization is completed, protect the new tissue from being strained by means of an equable support, either as applied through adhesive strips or by the use of a bandage.

## SECTION V.

### OF MORTIFICATION.

By mortification (*mors*, death, and *fio*, I become) is understood the loss of the vital functions of a part or the destruction of its organic texture, either in consequence of the action of some direct cause, as heat, cold, etc., or from the application of such means as produce immediate disorganization of the tissues, or from the effects of indirect causes, as the degeneration and destruction which ensue when tissues are deprived of that which is essential to their nutrition. As the mortification which results from heat and cold will be again alluded to under the heads of Burns and Frost-bite, attention may now be given to that which is due to the destruction of the local nutrition by general causes.

In the definition of inflammation, it was shown that the inflammatory process developed a change in the natural preservative action in the tissue cells of the part affected ; and it may, therefore, be readily understood that, when this process goes too far, it may end in their death, or the condition designated as mortification. Inflammation is, therefore, often closely associated both with the appearance of mortification as well as with the efforts of nature to check its progress and repair the loss which is thus occasioned. Mortification is, in fact, one end (death) of the chain of the inflammatory process, while resolution (health) is the other.

By surgical writers two distinct conditions of parts are recognized under the general term of Mortification—one, in which the superficial tissues are mainly involved, being named *Gangrene ;* while that which also involves the deep-seated parts, and thus induces the entire death of the part, is called *Sphacelus.* The term mortification should therefore be regarded as the generic expression characterizing in a general way the death of structure ; while Gangrene and Sphacelus indicate the specific extent or degree to which it extends. In gangrene there is usually noted the death of the skin, fascia, and muscles ; while the additional death of the blood-vessels, nerves, tendons, ligaments, and bones constitutes sphacelus.

The dead portion resulting from a circumscribed gangrene is usually spoken of as a "slough," while the process which results in it is designated as " sloughing."

By the term slough is also understood a yellowish, soft, pultaceous, irregular mass cast off by nature from adjacent vital tissues.

The symptoms of mortification are local and constitutional, both being modifications of such symptoms as have been alluded to under the characters of inflammation.

**Local Symptoms.**—In the local symptoms of mortification, as well as in those of inflammation, there may be noted change of color, heat, and sensation in the part, together with a modification of secretory action in it as well as in the organs of the general system.

When mortification has commenced, the *color* of the inflammation which generally precedes it is changed from the red of acute, and the more purple

tint of chronic inflammation to a hue which is of a darker character, being first brown and then black.    The *temperature*, also, either rises to that of the highest grade of inflammation, or else, as is more usual, falls much below the natural standard, till ultimately it reaches the cold of death.    The natural *sensation* of the part is also much modified on the occurrence of mortification, being sometimes very much increased, and at others diminished, until, as in death, the part becomes entirely devoid of sensibility.    The *effusions* or products resulting from the process of mortification are also of a peculiar character, differing materially from those seen in ordinary inflammatory action; the formation of lymph or of pus, so constantly seen in the different degrees of inflammation, being entirely absent in the mortified structure, though it may be present in the adjacent parts where nature is endeavoring to check the progress of the disorder.    The formation of serum in mortification is, however, greater than that which accompanies healthy inflammation, and usually shows itself more or less throughout the tissues which are involved; the cuticle being first elevated in patches, so as to form blisters or " phlyctenæ," and the subjacent parts being subsequently so infiltrated as to render them sodden, or as if liquefied.

The local disorder of secretion—modified tissue cell action—is also very evident; the degeneration and disorganization of the tissue cells resulting in chemical changes, by which gases are formed, and particularly that of the sulphuretted hydrogen or sulphydric acid.  In consequence of the presence of this gas, the areolar tissue soon becomes so infiltrated and distended as to crackle under the pressure of the finger, while, as the gas escapes into the atmosphere, it creates an odor which is highly characteristic of the presence of the disorder.

These changes have been thus minutely described by Förster, Robin, and others.*   Sulphuretted hydrogen, (HS,) phosphuretted hydrogen, ($PH_3$,) ammonia ($NH_3$) and its compounds, carbonic acid, ($CO_2$,) nitrogen,† (N,) and other gases, are evolved during mortification, and being disengaged not merely upon the surface but throughout the whole substance of the part involved, cause the peculiar emphysematous crepitation so frequently felt.  But besides these gaseous products of putrefaction, various liquid compounds, often of a highly irritating character, sometimes of strongly acid reaction, and the nature of which is not fully known, may result, acetic acid being often among these products.    The black color of many forms of gangrene is probably due to the liberation, during these chemical changes, of a certain amount of carbon from its compounds.    When it is borne in mind that the proximate elements of the blood and tissues, albumen, fibrin, musculin, etc. contain not merely carbon, hydrogen, nitrogen, and oxygen, but also phosphorus and sulphur, these varied products will not appear surprising.    A breaking up of the more complex proximate principles in the affected part by *oxidation* is probably the starting-point of these chemical changes, and while some of the ultimate elements are entering into combination with oxygen, others thus set free variously combine with each other.

In the slower decomposition, occurring in certain forms of *dry gangrene,* metamorphosis of nitrogenized compounds into *fat* appears to take place, and such specimens preserved in museums will continue to drip fat for a long time.‡

Sphacelus.—When the mortification goes still further, and that condition is produced which has been alluded to as *Sphacelus,* all these symptoms are increased.    The color is now no longer brown, as it was in gangrene, but

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* Förster, Manuel d'Anat. Path.  Translated by H. Kauln.  Robin and Verdeil, vol. i. p. 526.
† Robin and Verdeil, vol. i. p. 525.          ‡ Ibid., loc cit.

is rather of a dark, livid purple, or even black.   The odor also is changed, being either more heavy, or perhaps less offensive, especially if the liquid products of the disorder are rapidly evaporated, and as these liquids escape, there is usually more or less shrinking of the mass; the mortified parts becoming smaller and more shriveled than they were before.

If nature now endeavors to get rid of the decomposing mass, it accomplishes it by the development of healthy inflammatory action in the surrounding parts, which, leading to the production of lymph, results in a gluing together or adhesion of the neighboring tissues, as well as in the subsequent formation of the granulations of repair; while the same action (adhesive inflammation) in the blood-vessels closes the arteries for some distance from the dead structure, and thus prepares the part for the separation which is about to ensue. When the reparative inflammatory action has progressed still further on to the sound tissues in the neighborhood of those which are mortified, ulcerative action is established in those which directly join the dead parts; and it is by the continuation of the ordinary processes of ulceration as before described that these parts are finally separated from those which retain their vitality.

The progress of ulceration in separating the dead from the living structures presents two stages: in the first, a red color of a linear shape is produced by the inflammatory action in the skin, which resembles the red tint of acute healthy inflammation; and, as this soon separates the dead from the living tissues, it is known as the "**line of demarkation.**"   As the ulcerative action goes still further, the parts evidently begin to separate; a deep fissure or trench being formed, which becomes deeper and deeper, till the mass is finally thrown off.   This furrow, or deep ulceration, is known as the "**line of separation.**"   When this line of separation progresses to such an extent as to divide the muscles, nerves, blood-vessels, and bones, and leave a stump, we are again presented with the ordinary characters of a simple granulating surface, these granulations being formed by the organization of that lymph which was the result of the inflammatory action in the sound tissues, and which in the earlier stages prevented hemorrhage by circumscribing the ulcerative process, while it also closed the divided ends of the blood-vessels.

Fig. 152.



In studying the process of separation, it will be noticed that the different tissues resist it in various degrees, and preserve their powers for a greater or less length of time, in accordance with the degree of vitality, activity of their component cells, or the amount of blood circulating in them.   Thus, as a general rule, the arteries and the nerves are the last to mortify, although sometimes the bones resist the process of mortification the longest, in consequence of the denser character of their texture, and the amount of lime which enters into their composition.

**General Symptoms.**—The general symptoms which present themselves in cases of mortification may be described in almost one word as those of depression.   Being generally the result of irritation and inflammatory action, the symptoms of depression which accompany extended mortification exhibit chiefly the disorder of the nervous system, as reacting on the circulation. There is, therefore, usually a quick, irritable pulse, not unlike that of inflammatory fever, and which it is sometimes difficult to distinguish from the pulse
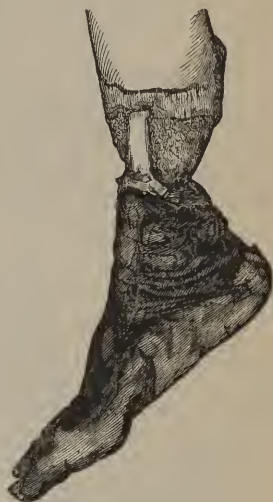
due to inflammatory action.    Indeed, the surgeon will often have to experiment somewhat in order to distinguish it, as may be done very safely by placing the patient for twelve hours on a full diet.    If the pulse diminishes in frequency under this treatment, it may be safely asserted that it is one due to nervous irritation, and not to inflammatory action ; and that, consequently, the free use of evacuants would be highly injurious.

Besides the derangement of the circulatory system, there is also disorder of the digestive apparatus, as shown in a dry, furred tongue, loss of appetite, with the other evidences of a typhoid disorder, such as diarrhœa, colliquative sweat, cold skin, etc.    As the typhoid symptoms are developed, the disorder of the nervous system becomes highly marked, and is shown in the anxiety of countenance, restlessness, insomnia, hiccough, floccitation, stupor, and death.

**Varieties.**—The varieties of mortification may be noted either in reference to the duration of the disorder, as *acute* or *chronic ;* or in reference to the condition of the affected tissue, being sometimes spoken of either as **Humid** or **Dry Gangrene**.    It is also designated as **Traumatic** when it results from a wound.

**Humid Mortification,** or **Gangrene,** is so called from the fact that a certain amount of moisture or liquefaction exists in the dead tissues in consequence of the accumulation of the liquid products which are formed upon its development, and are the result of the inflammatory action which usually precedes it.

**Dry Gangrene** is also often the result of inflammatory action, though usually of a lower grade than that seen in the Humid variety, the inflammation being sometimes so slight as to be almost imperceptible.    The effusions in this variety either form very slowly, or are much more limited in quantity, or escape more rapidly, though the first is most frequently the case, and hence the dry, shriveled character of this form of gangrene.

### ₹ 1.—Of Humid or Moist Gangrene.

**Causes.**—The cause of **Humid Gangrene** may be either inflammatory action or mechanical or chemical agents, or it may be the result of the obstruction of the venous or arterial systems.    It may also be produced by injuries to the nerves.    The manner in which inflammatory action results in gangrene has been already alluded to.    Under the head of mechanical causes may be placed gunshot wounds and fractures, which not unfrequently result in gangrene, as well as badly-applied bandages, the tightness of which have sometimes created it.    Under the head of chemical agents are to be found the application of the mineral acids, as well as that form of gangrene which ensues upon the escape of certain secretions into sound tissues, as in the infiltration of urine into the cellular tissue of the perineum and scrotum from rupture of the urethra.    Under the head of gangrene from injuries to the nerves may be classed cases of sloughing of the cornea from injuries to the fifth pair of nerves, and bed-sores, or even mortification of the feet after injuries to the spinal marrow, while it is also produced by obstructions to the circulation in cases of arteritis, calcareous degeneration of the arteries, etc.

**Diagnosis.**—Humid gangrene may be confounded by an inexperienced observer with a very simple and perfectly healthy condition of parts, as in a stump which has been closed with adhesive plaster, and in which the whole surface has become of a dark-brownish or blackish color, simply in consequence of the action of the sulphuretted hydrogen, liberated from the suppurating structures, upon the lead of the adhesive plaster, forming a sulphuret of lead.    The true character of this discoloration will, however, be at once

revealed by the fact that a sponge and a little warm water will readily re-move it.

A severe bruise may also be mis-taken for gangrene; but a bruise, in a day or two, will show its true char-acter; for, besides the absence of the constitutional symptoms which usually accompany gangrene, a bruise, which is black at first, soon becomes blue, and then yellow, or green, as is famil-iarly seen in the case of the ordinary black eye; it is also seldom accom-panied by phlyctenæ or the serous effusions, which elevate the cuticle.

**Prognosis.**—The prognosis of hu-mid gangrene will depend upon the cause, upon the age of the patient, and upon the condition of his general health, as well as upon the circum-stances in which he is placed, the prognosis of a case in private prac-tice being generally more favorable than it would be in the camp, on board ship, or in a hospital.

**Treatment.**— The indications for the treatment are—

*First.* To remove the cause, and when this is accomplished to remove the inflammatory action as far as pos-sible.

*Second.* To favor the separation of the dead from the living tissue.

*Third.* To support the strength of the patient.

In the selection of the means of ac-complishing these indications, much will depend on the particular case which is under treatment. Thus, in carrying out that portion of the first indication, which relates to the allay-ing of inflammation or the **local treat-ment**, there are cases in which local blood-letting may be of great service, although, as a general rule, it will be badly borne, and should be practiced with great caution. In carrying out the same indication, there may also be occasion to employ counter-irritants,

Fig. 153.



Humid Gangrene from the Strangulation of an In-jured Limb by a badly-applied Bandage. (After Jno. Bell.)

and these are much more generally serviceable. The counter-irritants useful in the treatment of humid gangrene may consist of stimulating poultices, stimu-lating washes or blisters, the latter being applied either close to the parts affected or removed some little distance from them, and placed on the per-fectly sound tissues, as suggested by Physick, of Philadelphia. Stimulating ointments are sometimes useful; such, for instance, as the Kentish ointment, as it is generally called, though properly a *liniment*, which is formed of resin

cerate and turpentine mixed together in the proportion of one part of oil
of turpentine to four parts of the resin cerate.

With the same object, and also to remove the fetor, such washes may be
used as are not only stimulating, but antiseptic in their character, as Labar-
raque's solution, or a solution of chloride of lime, or the antiseptic powder
of Cornè and Demeaux. Or, if these cannot be obtained, a stimulating poul-
tice made of raw carrots grated fine ; or the fermented poultice, as made
of porter or yeast mixed with corn-meal, and kept in a warm place until
fermentation is established, may be substituted.

Few plans of checking the progress of mortification and favoring the
formation of the "line of separation" have, however, proved more useful
in my hands than that recommended by Physick, to wit: the creation of
healthy inflammatory action beyond the diseased structure, by placing a strip
of blistering plaster around the limb just above the seat of the mortification.
If it is in a finger, place it on the hand; and, if in the hand, place it around
the wrist or forearm. The application of the nitrate of silver, or of the
tincture of iodine, are of much less value than the blister, their action
being generally more superficial, while the object of the treatment is the
development of a sufficient amount of healthy inflammatory action to excite
a decided effusion of lymph, and the commencement of reparative action in
the adjacent parts.

When gangrene has progressed so far as to result in *Sphacelus*, and
when, by the process of separation, the dead portion has been almost com-
pletely detached from the living, or is held only by a very limited attachment,
the dead portion should be separated at once from the living by the use of
the scissors or knife, in order to free the system from contact with the putre-
fying mass. It will also be useful to operate surgically where the liquid
effusions take place to such an extent as to threaten to do mischief, either
by being absorbed or by burrowing into the adjacent cellular tissue. In such
a case, several free incisions should be made through the skin and cellular
tissue, in order to facilitate the evacuation of these fluids, those which
escape being absorbed by bran or other dry powder and removed at the
subsequent dressing.

The **general treatment** of Humid Gangrene, or the fulfillment of the
third indication, consists in supporting the powers of life by the use of
tonics and stimulants, and especially by the preparations of bark, such as
the compound tincture of bark, or the sulphate of quinia, or the bark itself
in substance. The preparation of iron, especially that of the protocarbon-
ate generally known as Vallet's mass, with a full diet, should also be directed,
accompanied by the free use of malt liquors, or, if much depression supervenes,
by the free use of brandy. Opium is often of great service in the treatment
of this disorder, as it acts in two ways: first, by allaying pain and checking
the nervous irritation, thus diminishing the inflammatory action; and second,
by checking all other secretions, and yet acting on the skin so as to induce
perspiration.

### § 2.—Of Dry Gangrene.

When gangrene comes on slowly, or depends upon a very low grade of
inflammatory action, the part becomes dry, shriveled, and mummy-like, and
it is then spoken of under the specific term of **Dry Gangrene**.

**Causes.**—The causes of dry gangrene may be obstructed circulation, old
age, improper diet, diseases of the arteries ; such, for example, as calcareous
degeneration, or arteritis—the former, when combined with old age, being
very apt to produce it.

**Class of Patients.**—Dry gangrene is most frequently seen in hard drinkers, in men who are exhausted by gout, in old worn-out constitutions, in which the vital powers are below the normal standard.    In Europe it is said to be found not unfrequently among those classes of the population, particularly in Germany, who are compelled to eat the miserable brown bread of the country, which is made chiefly from rye that is more or less spurred.

**Symptoms.**—The symptoms of dry gangrene, when it has been developed from any one of the causes just named, are local tingling and coldness of the limb, with a change in the local circulation, as indicated by the modification of the color from its natural tint to that of a deep red, or brownish

Fig. 154.
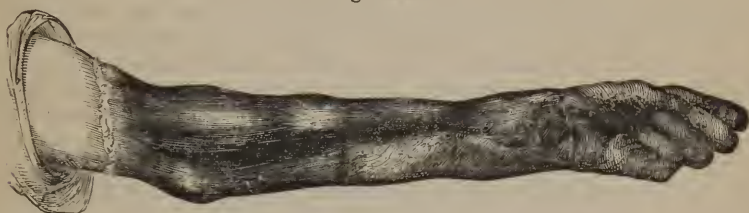


A representation of Dry Gangrene of the Arm, consequent on general debility in a patient aged seventy-five years.   The line of separation of the dead from the living parts is well seen.   (After Liston.)

hue.   Phlyctenæ, or the little bladders filled with brownish serum, already described, also frequently form, and soon burst, allowing the serum to escape, though they are also often absent, the parts becoming gradually darker in color, and being at last dried up and shriveled, until a mere shell remains as covering to the bone

When dry gangrene results from the use of bread that contains ergot in greater or less quantities, the condition is met with which is designated by many writers as Ergotism.   This disorder is often described by European surgeons, though rarely seen in the United States.   It may, therefore, be reasonably doubted whether ergot alone is the cause of its appearance, spurred rye being sufficiently common in certain sections of this country. Experiments have also shown that too much stress has probably been laid upon ergot as a cause of dry gangrene; many surgeons having considerable doubts of its power to produce this disorder, when not aided by the additional circumstances of calcification of the arteries, want of cleanliness, want of ventilation and of exercise, circumstances which are generally found combined among the peasantry of Europe, where ergotism is most common, and which, without the aid of ergot, would be quite sufficient for its production. The effects of ergot in creating gangrene have, however, been positively maintained by Thompson, in his work on Inflammation, and by some others, though post-mortem examinations were not made in many of these supposed cases.   In one of a similar character reported by Elliotson, of London, the examination showed the conjoined existence of calcareous degeneration of the arteries.

In connection with these opinions, it may be instructive and interesting to present a brief account of the experiments of Block upon the subject, made in 1811, which show that ergot does not readily produce dry gangrene in the lower order of animals.   "Block fed twenty sheep upon nine pounds of spurred rye a day, and kept them upon this treatment for four weeks, without finding that any injurious results were the consequence.   In another instance, twenty sheep consumed thirteen pounds and a half daily for two months, without injury.   Thirty cows also took twenty-seven pounds for

three months, with impunity; and two fat cows took in addition nine pounds of ergot daily, with no other obvious effect than their milk giving a bad caseous cream, which did not yield good butter."* Chickens have also been fed upon the ergot with like results, and in many instances it has been eaten by individuals in large quantities, either by accident or from necessity, without any injurious results. Medicinally, it is frequently given quite extensively in hemorrhages from the uterus; yet the cases in which it has produced any such effects as have been generally attributed to it are quite rare; and in all those recorded there has been the possibility of the existence of ossified arteries.

Among certain classes of people in the United States rye is largely used, and spurred wheat is not unfrequently seen; yet a case of dry gangrene which could be attributed to it is certainly rare—those supposed to be so having in two instances exhibited, on post-mortem examination, well-marked evidences of diseased arteries. Where ergot is aided by any of the causes which have been already detailed, such as old age, debilitated constitution, etc., it may have some influence in expediting the occurrence of the disorder; but that it will produce dry gangrene in a healthy patient, may, it is thought, be justly regarded as doubtful.

**Seat.**—Dry gangrene usually attacks first those parts in which the grade of vitality is lowest, and shows itself in the tips of the ears, at the end of the nose, in the fingers and in the toes, especially the latter. Having been once established, it will be found that its progress is very slow as compared with the humid form; but the prognosis is generally bad   A patient may recover from a very limited dry gangrene with a part of a limb, but by far the greater number of cases will terminate fatally.

**Treatment.**—In the treatment of dry gangrene, the indications are very much the same as those stated under the humid variety; thus it is necessary to keep up the temperature of the limb, to support the patient's strength, to favor the separation of the dead parts, and to watch the proper time for the performance of amputation.

The question of the propriety of amputation in any case of constitutional gangrene, whether humid or dry, is one which has been much discussed.   It is, however, generally regarded as the safest practice to await the formation of the "line of separation" before amputating, as the operation has often been followed by the reproduction of the complaint in the stump, when it has been performed before this has taken place, even though the amputation was made at some distance from the gangrenous parts.   In traumatic gangrene amputation is often promptly required.

### ¿ 3.—Of Senile Gangrene.

Another variety of dry gangrene is that to which professional attention was at one time called by Percival Pott, and to which he applied the term **Senile Gangrene**, because usually found in old men.   In consequence of his paper on this subject, the complaint is now often designated as **Pott's Gangrene.**

**Symptoms.**—The symptoms of **Senile Gangrene** are as follows: An old man, in a debilitated condition, or after some injury to the blood-vessels of a limb—such, for instance, as is sometimes caused by the fragments in a fracture, or after a fall which has created a strain, or after exposure to cold, or sometimes without any appreciable cause—wakes up in the night with excruciating pain in one of his feet, which he generally finds hot and swollen, and

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* Chelius's Surgery, by South, vol. i. p. 75, Phila. edit.

which he supposes to be attacked with gout or rheumatism, according as the pain presents itself in the ankles or toes. At the same time he will complain greatly of numbness, of cold, of a dead feeling, and of the other varied degrees of disordered sensation consequent on obstruction to the circulation in the part, all the various anodynes and narcotics failing to alleviate it or produce the slightest impression upon the suffering. After these symptoms have existed from one to five days, the surgeon's attention will be called to a small, reddish or brownish spot upon one of the toes, which soon becomes vesicated, loses its cuticle, is surrounded by an inflammatory areola, and rapidly runs on to mortification, presenting all the symptoms which have been detailed under the head of dry gangrene.

The points upon the foot at which this kind of mortification is most apt to show itself are the smaller toes or the top of the instep; whence it gradually progresses up the limb, resulting in the appearances shown in Fig. 155, and causing horrible suffering, till death closes the scene.

Fig. 155.
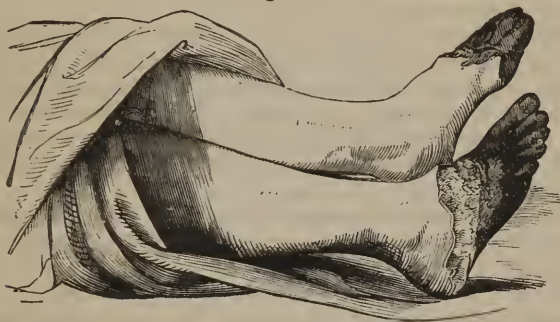


**Diagnosis and Treatment.**—This disorder, from its insidious commencement, is very liable to mislead the inexperienced; but the age of the patient, the seat of the disease, the violence of the pain without any appreciable cause, all tend to establish its existence. It has been and is most correctly ascribed to arteritis, to ossification of the valves of the heart, and to obstructions in the local circulation, the disorder being nearly always fatal, no matter what treatment is resorted to. Anodynes, internally and externally, afford the greatest relief, while warm and stimulating applications are the most rational means of carrying out the local treatment.

### § 4.—Of Hospital Gangrene.

Another form of gangrene, to which attention should be given, is that known as **Hospital** or **Epidemic Gangrene**—a condition which generally indicates an impure atmosphere, or some neglect respecting the patient's strength. Sometimes, however, it appears in hospitals in spite of the greatest precautions, assuming an epidemic form, and causing the destruction of every part which it attacks, and is doubtless due, as suggested by Bennett, to some electrical change in the atmosphere, yet unexplained, powerfully influencing the chemical combinations of the diseased part, and thus preventing cell growth.* When such a state of affairs occurs

* Opus citat.

in the wards of a hospital, every sore begins to slough; the slightest as well as the most severe wounds sharing the same fate, and presenting more or less of the following symptoms:—

**Symptoms.**—First a change in the character of the wound, which loses its healthy florid appearance, a white film-like membrane overspreading the granulating surfaces, and indicating an arrest of the healthy processes. The pus, also, is either entirely dried up, or much changed in its characters, becoming ichorous and unhealthy; the parts slough with great rapidity, while typhous symptoms, or those of excessive prostration, quickly precede the fatal issue.

**Treatment.**—When epidemic gangrene has been established in the wards of a hospital, there is but one thing to be done; let in plenty of fresh air, clear out the wards, turn the patients into the street, if nothing better can be done, or place them in tents; do anything but allow them to remain in the building. Ventilate the wards, fumigate, paint, scrub, whitewash; and then, perhaps, when after two weeks they are reopened, the surgeon will have the satisfaction of seeing that the tendency to this form of gangrene has fortunately been arrested.

Still, in spite of every means that can be adopted, this disease will sometimes progress; and many instances are known to surgeons in which patients have lost their lives from the sloughing of ulcers which originally were not larger in size than a twenty-five cent piece. I have also known more than one instance in which amputation has been required in stumps that were so nearly healed, that a mere spot, no larger than a sixpence, alone remained to be cicatrized.

The additional treatment demanded by Hospital Gangrene over the general sanitary plan just alluded to, as well as that advised under the head of Humid Gangrene, is the use of the strong nitric acid, applied to the dead part on cloths wet with it, poured over the surface, or painted on it with the camel's-hair pencil. While the action of the pure acid is limited to the parts already dead, and the removal of which it hastens, the structures immediately adjacent, which retain some vitality, may be occasionally wet with a diluted acid, the strength of the solution being fifty drops of the acid to a quart of pure water, as suggested by Sir A. Cooper, though sometimes the patient will bear it less diluted. This application should create some little sensibility in the part if it is to prove useful.

# CHAPTER III.

## OF THE SPECIFIC FORMS OF INFLAMMATION.

AFTER the detailed account of the ordinary forms of inflammatory action that has been presented, attention may next be given to such modifications of inflammation as are seen when the disorder is developed under peculiar circumstances, to wit: when it is seated in the areolar tissue, as in Furuncle; or excited by unhealthy causes, as Erysipelas. In these affections certain peculiarities may be noticed which require special consideration.

## SECTION I.

### OF THE FURUNCLE, OR BOIL.

The Furuncle, (from *furo*, to rage,) or boil of common language, is a circumscribed inflammation of the derm, or of the areolar tissue, which is usually attended by violent inflammatory action, followed by the death of the circumscribed portion of the skin which is over it, and by the separation of the central portion from the adjacent parts in the form of a slough or "core," as it is usually termed.

**Seat.**—The furuncle or boil may show itself on any part of the body, but especially on parts where the skin is liable to friction or irritation, or where it is thickest, as about the deltoid or gluteal muscles, on the thigh, or on the neck, and back of the head of persons who are in the enjoyment of good health, and who have been exposed to some slight exciting cause, as the chafing of a pimple or of an obstructed sebaceous follicle, or to some irritation about the root of a hair.

**Symptoms.**—The earliest sign of its presence will be found in a circumscribed redness, attended with considerable burning and a violent throbbing, pulsatile pain, after which swelling occurs, the part being raised more or less above the level of the surrounding parts, as a conical eminence, with a firm, hardened base.    The summit of this cone soon presents a softened point, in which pus is quickly apparent.    On the occurrence of the suppuration, the pain and irritation diminish, though the swelling continues, and is soon followed by the bursting of the skin, the escape of a thick, yellow, and healthy pus, and the creation of a rugged, circumscribed ulceration, which leaves apparent in the sore a soft, pultaceous, yellowish slough, which is generally described as the "core."    After a few hours or days, this core escapes, and the skin heals rapidly, though it is left tender and often redder than is natural.    After the lapse of a few days or weeks, another boil is apt to be located in the immediate neighborhood of the first.    This also runs its course, and may be followed by various others, either near it or at some other portion of the skin, it being commonly remarked "that one boil makes many."

**Diagnosis** and **Prognosis.**—The superficial and limited character of the inflammation, and the robust health of most of those who suffer from furuncle, generally suffice to distinguish boils from any other complaint; while the prognosis as to the ultimate result is favorable, barring the tendency to a reproduction of the disorder.

**General Treatment.**—As boils are usually found in those who are free livers, and whose digestion and secretions are somewhat disordered, the best plan of treatment is to administer a full dose of blue pill at night, and follow it next morning by a saline cathartic; repeating the cathartic in twelve hours if its action is not quite free.

The **Local Treatment** should consist in the application of heat and moisture by means of the warm water-dressing, or by means of hot emollient poultices; or the popular stimulating salve of brown sugar and soap may be employed to hasten the suppuration.    When pus is certainly formed, *but not before this*, the skin should be punctured and the matter evacuated, but without disturbing the core, the latter being left to be thrown off by nature, aided by the subsequent application of heat and moisture.    Much unnecessary pain is often caused by puncturing a furuncle before the pus is fully formed, and this practice should therefore be carefully avoided.    A little calamine cerate, or the cold cream of the shops, or the tallow of domestic

use, generally suffices for the dressing of the ulcer, the healing of which is not usually a matter of difficulty.

To prevent a reproduction of the complaint, close attention should be given to the diet, which should be chiefly vegetable, while frequent purging with saline cathartics, and the removal of all local sources of irritation, will generally prove useful.

## SECTION II.

### ANTHRAX, OR CARBUNCLE.

The Anthrax, or Carbuncle, or *furunculus malignus*, (ανθραξ, a coal, *carbo*, a burning coal,) a malignant form of the boil, which deeply involves the subcutaneous areolar tissue, is a truly gangrenous form of inflammation in this tissue, which has an especial predilection for the back of the head, neck, and shoulders, as well as for the thigh, buttock, and arm of the middle aged, or those advanced in life, who have been addicted to eating and drinking, especially the latter, though sometimes it is also found in the most abstemious. When a carbuncle is once developed, it generally terminates in the death of the integuments at the point affected, and though comparatively rare, this affection also occasionally prevails epidemically to a limited extent.

**Local Symptoms.**—After a short period of uneasiness, fullness, and irritation in the part, which is followed by great heat and an intense aching pain, vesication of the cuticle is seen, accompanied by great burning. On examination of the seat of the disorder, a circumscribed, firm, and hard swelling, which is evidently deep seated, is apparent. This soon assumes a dark purple or livid color in its centre; immediately after which numerous vesicated points appear and give exit to a brownish sanies. Shortly after this, a little brown or black slough shows itself, which seems, from its color, and from its resemblance to the condition created by the application of a burning coal, to have given rise to the name of the complaint. As the disorder progresses, the various vesicated points become the seats of numerous small ulcers through which the dead areolar tissue protrudes as a soft pultaceous mass, which is ultimately thrown off, if the patient sustains the irritation, thus leaving a wide but superficial ulcer, which shows but little disposition to heal.

**Constitutional Symptoms.**—Soon after the first appearance of the local disorder there is a chill, followed by fever, and the pulse exhibits signs of irritation. This is soon succeeded by many of the symptoms of a typhoid condition, as nausea, loss of appetite, costiveness, or diarrhœa, with a furred tongue, inability to sleep, great restlessness, headache, or even delirium. There is also often difficulty of breathing, colliquative sweat, fainting, subsultus tendinum, and hiccough, all which may terminate in a return to health, but which in old persons, and especially when the disorder is seated near the head, frequently ends in death.

**Diagnosis.**—The age and constitution of the patient, the pain and gangrenous tendency of the inflammation, with the peculiar seat of the disorder generally, suffice to render the diagnosis of carbuncle from the furuncle or common boil sufficiently easy.

**Prognosis.**—The prognosis is dependent on the size and seat of the affection, the age and character of the patient, and the early period at which the surgeon is called in. From the serious constitutional disturbance which often accompanies carbuncle, the prognosis should always be guarded.

**Treatment.**—The indications in the local treatment of carbuncle are, first,

to excite healthy inflammation in the skin; second, to favor the exit of the gangrenous areolar tissue; and third, to create healthy inflammatory action. In the milder forms of the disease, where it is apparently threatening an invasion, that is, while the skin is only discolored but not livid, and before ulceration is established, it is sometimes useful to apply a blister upon the part, so as to excite healthy action, this application being followed by the use of the warm water-dressing. But, unless seen at an early period, this mode of treating carbuncle will not prove of much service, and sometimes greatly augments the patient's suffering. In more severe cases, it is all-important that attention should be first given to the entire destruction of the skin which is involved in the disorder, and to the evacuation of the slough.

The treatment suggested by the late Dr. Physick, of Philadelphia, and specially applicable to those cases in which there is an evident mortification of the subcutaneous areolar tissue, consists in making a sufficiently long crucial incision entirely through the skin deep into the sloughing tissue, after which a stick of caustic potassa (Kali purum) should be rubbed throughout the line of the cut and all over the surface of the livid skin, until it becomes black and is converted into an eschar. After this free application of the caustic, for a few minutes the part should be thoroughly wet with sweet oil or vinegar, in order to neutralize the caustic, while the surrounding sound skin, especially that over which the discharge will flow, should be also painted with sweet oil, or well greased with cerate in order to protect it. This application of the caustic, if thoroughly made, destroys entirely the extreme pain of the disease, and gives the patient prompt and efficient relief. When the carbuncle has been thus cauterized, it should be covered with a fermenting or yeast and corn-meal poultice, which should be spread on oiled silk, and renewed every four hours. As soon as the parts show a disposition to throw off the dead mass, the flaxseed poultice or the warm water-dressing may be substituted, this, like the fermenting poultice, being also changed three times a day, in order to get rid of the irritating and fetid discharge which escapes from the sore. When the carbuncle is seated on the upper part of the neck, these dressings can be best retained in position by means of the four-tailed sling, as represented in Fig. 84. But when it is seated on the back of the shoulders, there is no dressing which is neater or more thorough in its application to this part of the body than the scapulo-dorsal handkerchief of Mayor, Fig. 108, p. 156.

After the separation of the slough, the ulcer should be treated on the general principles of healthy ulcers by means of the warm water-dressing, to which may be added a little of the aromatic wine of the French pharmacopœia if the granulations seem to require stimulation. A half ounce of the wine to two ounces of water applied by means of lint wet with it is sufficiently strong, though sometimes the anodyne wash of Cooper, as advised in the treatment of the irritable ulcer, answers admirably. Mild ointments, as the calamine or red precipitate or basilicon cerates, are also useful as a change of dressing when the cicatrization appears to be tardy. But it is not unusual for a bad carbuncle to require six or eight weeks before it heals, even under favorable circumstances.

**Constitutional Treatment.**—Throughout the entire period of the local treatment, attention should be given to the constitutional symptoms connected with carbuncle. If the patient is seen early, and the digestive organs are loaded, an emetic followed by a mercurial cathartic is generally useful, after which the nervous irritation should be allayed by the free use of opiates and diaphoretics, especially the Dover's powder. Owing to the severity of the pain, large doses of opiates, as from two to four grains of opium in twenty-four hours, may be demanded. At the same time the patient's strength

shonld be supported by quinine in doses of twelve to twenty grains a day, combined with a nutritious diet, and when prostration becomes evident, the stimulants should be augmented by the free use of alcoholic drinks, the previous habits of the patients as well as their age not unfrequently rendering such articles essential to the maintenance of the powers of life. In fact, the constitutional treatment should be conducted on the plan already mentioned under the head of mortification.

## SECTION III.

### OF ERYSIPELAS.

The next complaint to which attention may be given is a peculiar form of unhealthy inflammation designated as **Erysipelas**.

The name of this complaint is derived from two Greek words, $ερυω$, I draw, and $πελας$, near, and points out the marked tendency of the disease to spread itself and involve adjoining parts.

It has been called "the Rose," from its color, and St. Anthony's fire, from the burning character of the pain, and from the supposed power of the saint to cure it. If limited to the skin alone it is called **Simple** erysipelas, but if the subjacent areolar structure is involved it has the appellation of **Phlegmonous** erysipelas. It also receives various names from accidental complications; thus it is called **Oedematous**, when there is serous effusion into the surrounding cellular tissue; **Bilious**, when complicated with disease of the portal circle; **Erratic**, when it frequently changes its seat, disappearing in one part and reappearing in another; **Idiopathic**, when it results from constitutional causes; and **Traumatic**, when it follows upon some external injury.

Erysipelas may be defined as "an inflammation of the skin and subjacent areolar tissue, characterized by the deep-red color and swelling of the affected part, and by a marked tendency to spread."

**Seat.**—It seldom exists, except under peculiar circumstances, in any other part than the skin and adjoining areolar tissue.

**Symptoms.**—The symptoms of erysipelas are of two classes, constitutional and local; the former generally preceding the latter. Thus, when the erysipelas is about to appear there is, in the first place, frequently a severe chill, with pain in the back and limbs; nausea; loss of appetite; vomiting of bile; stomach irritable, and disposed to reject even small quantities of liquids; great restlessness; frequent and often feeble pulse; dry tongue; great anxiety and despondency, which is soon followed by defective secretions of all the glands and the symptoms formerly detailed under the head of Inflammatory Fever, though in a more marked degree if the disorder is epidemic. At various periods of these constitutional symptoms, local changes become apparent, the secretions of the wound are modified, and the character of its surface is changed, as is shown by the difference in its color, as well as in the character of the pus, the surface of the wound or ulcer being covered by a green, thin, offensive, irritating ichor; the edges also show unhealthy action, and have, in some instances, a marked tendency to slough. Soon after the occurrence of the primary constitutional disturbance, though sometimes preceding it, a change will be apparent in the skin in some cases, even when there is no wound, as after violent contusions followed by ecchymosis. The skin rapidly becomes of a bright arterial red, or of a yellowish or brownish hue, and is elevated into blisters by the serous effusion under the cuticle, or it is hard, dense, and unyielding, from the lymph

which accompanies the serous effusion. In bilious erysipelas there is also more or less of a jaundiced hue apparent, which renders the color browner than is usual in cases uncomplicated by deranged biliary secretions. In phlegmonous erysipelas, suppuration, and sometimes sloughing of the areolar tissue, supervenes, and materially complicates the case. As the disorder progresses, the skin is usually more vesicated and the color variegated, with an edge which is separated by a margin of a marked color from that of the healthy structure.

After these changes in the condition of the integuments, local affections of the internal organs may complicate the disorder. Sometimes the serous membranes become involved and create peritonitis, as after wounds of the abdomen; or there may be inflammation of the brain, as after injuries of the scalp. Sometimes also in both these instances the mucous membranes are involved, and diarrhœa appears.

The pain of erysipelas is characteristic of the disorder, and is described as of a burning, tingling, irritating kind, the approach of the attack under conditions favorable to it being indicated by this fact.

Etiology.—The etiology of erysipelas is extremely doubtful; many causes having been assigned, but none, so far as is positively known, which can be regarded as a constant source of the complaint. Thus, the disease has been said to originate in bilious and gastric disorder; from the presence of irritating ingesta, and from acidity of the stomach. But occasionally it is found to exist independently of these conditions, as well as in cases where the slightest indiscretion could not be charged on either patient or surgeon. By many it has been supposed to depend upon some peculiar condition of the atmosphere. That this disorder is in some way dependent on a vitiated condition of the blood, is now generally believed, and apparently proved by the beneficial result of all treatment directed to the improvement of this important fluid; but how the blood becomes affected, is as unknown and inexplicable as is the case with typhus fever and many other zymotic diseases.

As a source of local irritation, tending to the localization of the inflammation, many have thought that the employment of adhesive plaster was especially injurious, as its removal in the dressing of wounds irritated the cutaneous follicles by pulling out the hairs of the skin; but in many instances, even with a tendency to the disorder, it has not invariably followed the use of adhesive strips. The alternate compression and expansion of the capillaries, under the application and removal of a bandage, have also been regarded as exciting causes; while heat and moisture, cold, etc., have all been supposed to be equally powerful excitants of it. It is apparent, therefore, that but little is known respecting the etiology of the complaint.

There is one fact which deserves mention in connection with erysipelas, and that is, the conjoined existence of puerperal fever and phlebitis during the same period. This singular coincidence has led to many discussions, and volumes have been written without adding very materially to our understanding of the matter. It is right, however, that this coincidence should be remembered, even though unexplained, because while attending a case of erysipelas, a surgeon ought *not* to attend one of midwifery, lest puerperal fever should be developed in the woman.

The connection between these two complaints has frequently been exhibited in hospitals, and especially in the Pennsylvania Hospital, of Philadelphia. In the latter institution, the long surgical ward was at one extremity of the building, and the obstetric department at the other end of the grounds; these buildings were therefore separated by several hundred feet of open space; the medical officers and nurses were also different, and no intercourse

existed between the two; yet frequently erysipelas became epidemic in the surgical ward, while puerperal fever prevailed in the lying-in department. So also, on the other hand, practitioners making *post mortems* of puerperal peritonitis have not unfrequently had erysipelas developed in their own persons. In explanation of these singular phenomena, it has been said that in both there is phlebitis, that there is a marked sympathy existing between serous membranes and the skin, etc. etc.; but nothing satisfactory has yet been suggested which is admissible as an explanation in the majority of cases.

**Diagnosis.**—In studying the symptoms of erysipelas more in detail, it will be seen that its redness has some peculiarities which distinguish it from the redness of ordinary inflammation. At first, the erysipelatous redness spreads rapidly; but, after its primary violence is spent, it ceases to extend, or more frequently extends irregularly, giving to the margin a feathered edge, which is quite characteristic of the complaint. The creation of this edge is said to be due to the fact that the inflammation is of the unhealthy variety, in consequence of which there is no formation of lymph to limit the progress of the inflammatory action; but when the production of serum takes place, as it generally contains more or less lymph, an imperfect limitation may be noted, and the color therefore spreads irregularly. In conse-

Fig. 156.
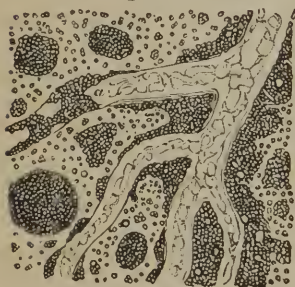


quence of a certain similarity of symptoms, erysipelas may be confounded with erythema or phlegmon, or with simple redness of the skin produced by irritation, such as the chafing of the clothes or the action of the sun. A patient, for instance, may be brought into a hospital with redness or even vesication of the back of the neck and head, and at first erysipelas might be suspected, but the history will generally show that the color is only the result of a very delicate skin, having been exposed for some time to the direct rays of the sun. Usually there is but little difficulty in arriving at a correct diagnosis in erysipelas; the history of the case, the symptoms, as the burning character of the pain, etc., and the absence, in cases not erysipelatous, of the constitutional symptoms generally present in the disease, will be quite sufficient to guide the surgeon in the formation of an opinion.

**Prognosis.**—The character of the prognosis of erysipelas will depend very much not only upon the extent of the disease, but also upon the nature of the region that becomes the seat of the eruptive action. Thus, erysipelas in the scalp would be much more dangerous than erysipelas in the extremities, on account of the possibility of the first involving the membranes of the brain.

The terminations of erysipelas are two in number. 1. It may end by resolution. 2. It may terminate by suppuration. In most instances, where there is a circumscribed erysipelas which is limited to the skin, its tendency will be to resolution. If, however, it invades the areolar tissue, it will most probably end in suppuration.

Among the constitutional symptoms, moreover, are certain which have an influence upon the prognosis. When the pain in the back is very severe, for example, we may, as a general rule, expect to have trouble. The habits of the patient also influence, in a very marked degree, the prognosis, erysipelas in an intemperate person being much more serious than in one of temperate habits. The previous history of the case should also have its weight

in the formation of a prognosis, as an attack supervening in a patient who has been exhausted by a long suppuration would be much more serious than one occurring after a recent injury.   When erysipelas assumes an epidemic character it is much more serious than when simply sporadic; and its repetition is materially affected by the state of the weather, mild and dry weather being much more favorable than that which is cold and damp; hence erysipelas is especially prevalent in February and March, in the latitude of Philadelphia.   The prognosis, in some instances, will also be influenced by the circumstances of the patient, as whether he can have fresh air, good diet, and all those little comforts which are needed by the sick, or whether he is deprived of these by his position; whether the surgeon finds him in private practice or in the wards of a hospital, erysipelas developed in a hospital being much more apt to prove serious, and to cause sloughing, than the sporadic cases which occur in private practice.

Treatment.—The treatment of erysipelas will depend upon circumstances. If it appears near a wound, the first indication is to allay local irritation. In doing this, everything calculated to inflame the skin should be carefully removed, as bandages and adhesive plaster; the warm or cold water-dressing being substituted, in accordance with the feelings of the patient.

But generally the treatment of erysipelas must be directed almost entirely to the constitutional derangement, the local disturbance being only evidence, as a general rule, of a blood disorder of an asthenic character, the treatment being entirely based on this principle: In the first place, it is good practice to administer an emetic, as it empties the stomach, gets rid of indigestible articles, and affects favorably the portal circulation, after which a free mercurial or saline purgative should be given so as thoroughly to empty the alimentary canal and act as a revulsive from the skin.   When this is done, resort may then be had to diaphoretics; and, among these, nothing is better than Dover's powder, the ipecacuanha modifying the action of the circulation in the skin by the perspiration it produces, thus equalizing the local circulation and aiding in eliminating the noxious matter from the blood, while the opium serves to tranquilize the existing nervous excitement, especially by securing sleep.   Throughout the treatment it cannot be too forcibly impressed on the mind of an inexperienced surgeon, that the disorder is an eruption on the skin, mainly dependent on a vitiated condition of the blood; that diuretics, chalybeates, and tonics should be freely administered; the local treatment being merely palliative remedies.

When erysipelas is of an epidemic character, and has a special tendency to assume the asthenic form, stimulants are required from the very commencement.   Indeed, in the forms of traumatic erysipelas, and among patients suffering under the depressing influence of serious injury, as in complicated fractures, amputations, etc., no plan of treatment has proved more useful in my hands than that of stimulants both in food and drink, after the use of a thorough mercurial purge.   In some instances, and especially in those who have been high livers, I have administered in twenty-four hours over a pint and a half of the strong beef essence as made by Liebig's formula,* together with twelve ounces of the best brandy, and fifteen grains of quinine; the pulse under this treatment sinking from 120 to 98 in the minute, while it lost its irritability.   The tongue also became more moist, and cleaner, and a free perspiration, accompanied by sound sleep, proved of great comfort to the

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* Beef, free from fat, and cut into small pieces, ½ pound; muriatic acid, 4 drops; salt, one teaspoonful; cold water, 12 ounces.  Let it macerate for two hours—then pour it through a sieve, and pour the water a second time over what remains on the sieve.   This beef essence, when well made, is almost as clear and free from color as water, and is entirely devoid of the empyreumatic odor of the older formula.

patient. When, however, such a plan of treatment increases the frequency of the pulse, so as to cause it to count 140 or 150, while the skin becomes drier and hotter, and the tongue browner or drier, it will do harm, and should be superseded by saline cathartics, cremor tartar water, spirits men- dereris, or other mild diuretics, with warm gruel, or other diluents, until signs of debility are apparent. Great caution should always be em- ployed in this as in other diseases, in deciding between the inflammatory or debilitated and irritable pulse; and there is no better mode of settling its true character than by testing the effects of stimulants. If the frequency of the pulse diminishes, and the patient perspires freely under their em- ployment, stimulants will prove useful, but not otherwise. After employing eliminating remedies, as gentle purgatives, diaphoretics, and diuretics, the free use of the "tinctura ferri chloridi," with or without the use of alcoholic stimulants, will prove a most valuable adjuvant to the treatment. The ad- vantage of the tincture over other chalybeate preparations is to be found in its solubility, as well as its diuretic tendency.

In the local treatment of erysipelas, little or no benefit need be expected from external applications, except in so far as they may add to the patient's comfort or protect the part from the action of external irritants. The most comfortable of the local applications is lint wrung out of warm flaxseed or slippery elm mucilage, and covered after its application with a piece of oiled silk, or an "arrow-root poultice;" or if there is a free discharge from a wound, covering the part, especially if in a limb, with a thick layer of wheat bran, which will absorb the matter and shield the skin from the atmosphere. Cloths, wet with a solution of the sulphate of iron, twenty or more grains to the ounce of water, or stronger, were at one time highly lauded by Velpeau; but even in his own wards, as well as in those of American hospitals, this has, according to my experience, not sustained the character which was at first given to it. The iron is also a dirty dressing, as it stains all clothes that it touches. The perchloride of iron, in the proportion of one part of the salt to three of water, is also highly spoken of by the French surgeons; but its results are similar to those of the sulphate. Frictions, with mercurial oint- ment, washes of nitrate of silver, of the tincture of iodine, etc., have also disappointed many who have relied upon them, and, in the vesicated form of erysipelas, often prove a source of additional suffering. Nor will the attempts to check the progress of the disorder, by drawing a circumscribing line between the sound and the diseased skin, prove of much service, as it has over and over again passed its boundary without even temporary delay; and the same is true of strips of blistering ointment.

It is therefore deemed injudicious to rely on a local treatment of erysipe- las, except as a palliative; and among these, the mucilages are decidedly the most soothing, especially when combined with extracts of opium, aconite, or belladonna. When lead-water is employed, the deposit of the lead on the skin renders it stiff and painful; and when laudanum is added, the deposit of opium by chemical action augments this evil. In all cases the importance of the constitutional treatment cannot be too strongly impressed on the mind of the young surgeon, and especially the utility of invigorating the powers of life after the use of such purgatives and diuretics as will correct the action of the emunctories.

In phlegmonous erysipelas, when suppuration is evident and the tissues are sodden and boggy from the liquids infiltrated into the areolar tissue, free incisions at various points, so as to evacuate the pus and dead tissue, will often be required, and expedite the cure by hastening the natural process.

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# PART III.

## SPECIFIC DISORDERS RESULTING FROM PERVERTED NUTRITION.

UNDER the head of **Specific Disorders,** or those presenting special and characteristic symptoms, while dependent on a disordered nutritive action, in which the constituents of the blood seem to be directly involved, may be placed **Tuberculosis** and **Syphilis.**

## CHAPTER I.

### OF TUBERCULOSIS.

As the full consideration of the subject of tuberculosis would far transcend the limits of this work, and as very many of the disorders included under this head fall rather within the domain of the physician than of the surgeon, the present remarks will be confined to the surgical relations of the affection; before doing which, it will be necessary to present the leading facts connected with the pathology of the disorder.

The term **Tuberculosis** is applied to that condition of the constitution in which a peculiar new formation or deposit designated as *tubercle* makes its appearance in various tissues and organs of the body. It has also been named the *Tuberculous* or the *Scrofulous diathesis*—words which are used synonymously by the best pathologists of the present day, though some writers even yet endeavor to make a distinction, limiting the term Struma or Scrofula to those cases in which the tubercle is deposited in the peripheral portions of the body, as the superficial lymphatic glands, while those in which it is deposited in the lungs and other internal organs are spoken of as manifestations of the tuberculous diathesis. Some have also imagined and described anatomical differences between the deposit of tubercle

in these two classes of cases, in which, however, they are not borne out by the majority of investigators.   In the present treatise the two words will be used synonymously.

**Etiology.**—It is generally admitted that the Scrofulous diathesis may be transmitted from parent to child, and it is hence described by authors as originating in the majority of cases in a hereditary taint.   But it also originates in individuals of healthy parentage; hence it will be correct to state that it may owe its origin to whatever is capable of impairing the general nutritive powers of the individual.   Thus tuberculosis often appears as a sequel to some exhausting disorder, as scarlet fever or small-pox, or it may result from want of proper food, exercise, ventilation, and light.   Indeed, depressing causes of any kind appear to be capable of developing tubercular deposits —a fact of the greatest practical importance, since it clearly indicates the value of proper hygienic measures, and of the tonic and supporting treatment that has been so successful in the relief of these deposits.

**General History of Tuberculosis.**—Many points of great interest are known in regard to the general history of tuberculosis, a few of which may be here indicated :—

*Age.*—Tuberculous affections are most frequent in the young.   While they are *possible* at any period of life, the majority of cases occur in individuals under thirty years of age, after which period their frequency steadily diminishes.   In this they are in marked contrast with cancer.

*Sex.*—They are somewhat more frequent in females than in males.

*Occupation.*—Persons of sedentary occupations are more liable to these disorders than those whose business compels active exercise.

*Individual Peculiarities.*—Much has been written with regard to the peculiarities of organization manifested by those who are most liable to tuberculous deposits.   It is generally affirmed that individuals with delicate and fair complexions, light, fine hair, blue or light-gray eyes, thick upper lips, tumid abdomens, and precocious minds are especially susceptible.   But the disease may often be noted in those with dark hair and eyes, thick, muddy skins, and sluggish intellects.   It is also frequent in the United States among mulattoes and negroes, especially the former.

**General Symptoms.**—When tuberculosis is fairly established, which can only be positively affirmed after a deposit of tubercle has taken place, certain general symptoms make their appearance, and progress with such uniformity that they are spoken of as the manifestations of the tuberculous diathesis.   These phenomena are essentially those of a steadily progressive want of proper nutrition and assimilation resulting in anæmia, and manifested by disordered digestion, impaired development of the various tissues and organs, with general debility and exhaustion, to which, when the local processes are sufficiently severe, as in the case of tuberculous cavities of the lungs, of destructive tuberculous disease of the bones and joints, etc., hectic fever may be superadded.

**General Anatomy of Tubercle.**—The peculiar product called tubercle may occur in any vascular tissue, or even upon the free surface of serous and mucous membranes.   It may manifest itself under a miliary, infiltrated, or encysted form; that is, as numerous little irregular bodies about the size of a millet-seed, or as larger masses specially designated as infiltrated tubercle, of a yellowish or dirty-white color, varying in consistence from tough cheese to cream.   The essential diversity between these varieties, however, is only as to their size, for the smallest tubercle, when it occurs in the parenchyma of an organ, is in fact an infiltration; that is, it contains more or less of the normal textures imbedded in its substance.   In accordance with their color, tubercular deposits are divided into two varieties, the gray and the yellow.

In their minute structure both these varieties are very similar. *Gray tubercle* consists essentially of a tolerably firm, solid, homogeneous, transparent, or dimly-granular matrix, in which are imbedded the involved normal textures, generally in a more or less atrophied condition, and innumerable dark-contoured angular bodies of minute size, $\frac{1}{3000}$ to $\frac{1}{4000}$ of an inch in long diameter, to which the name "*Tubercle corpuscles*" has been applied. *Yellow tubercle*, in addition to these elements, presents—imbedded in the matrix, in the corpuscles, and the involved textures—a considerable number of extremely minute oil globules. It is, therefore, highly probable that, in many cases at least, yellow tubercle is merely the result of the fatty degeneration of the gray, though it must be admitted that, in some cases at least, tubercular deposits may have the characters of the yellow variety from the earliest moments of their existence. Tubercular deposits of either variety do not, however, retain permanently the characters above described.

Gray tubercle undergoes fatty degeneration and is transformed into the yellow. Or in more favorable cases it shrivels, withers, becomes horny, diminishes much in size, and ceases to exert an injurious effect upon the surrounding tissues.

Yellow tubercle sooner or later softens, and is ultimately converted into a yellow liquid not unlike unhealthy pus, in which little cheesy-looking masses float. If softened tubercle be examined by the microscope, the tubercle corpuscles can still be recognized, the oil globules are more numerous and larger than before, and plates of cholesterin may be observed more or less abundantly. It is probable, therefore, that the softening of yellow tubercle is due to an extreme degree of that fatty degeneration by which gray tubercle is converted into yellow.

By the same process of degeneration, the textures involved in the tuberculous infiltration are more or less completely destroyed, and a tubercular cavity filled with softened tubercle is the result. The tubercular cavity thus formed may enlarge in size by the deposit and liquefaction of fresh tubercular matter on its periphery, but very often true inflammation is developed in the adjacent textures, and the cavity enlarges until it finally discharges on some free surface by a process essentially the same as that by which an ordinary abscess opens itself. The matter discharged from such a tuberculous abscess is generally softened tubercle more or less abundantly mixed with pus.

Under more favorable circumstances, but far less frequently, softened tubercle undergoes a change called *cretefaction* — a change consisting essentially in the accumulation of various earthy salts, but chiefly the phosphate and carbonate of lime in the tuberculous mass, which is ultimately converted into a hard, friable substance, and ceases to exert any injurious influence.

**Origin of Tubercle.**—The source of tubercular deposits is a question that has been much discussed by pathologists, and by no means satisfactorily explained. If the views of cell action presented by Addison and Virchow are recognized as correct, the tuberculous matter may be regarded as the result of a necrosis of other cells or of glands, the local nutrition of which is impaired by the impoverished character of the blood furnished through the general circulation; hence the material that should have added to their increased nutrition is left outside of the cell after being attracted from the blood, and partially acted on by the cells until by gradual accumulation it results in the substance known as miliary tubercle. Aggregation of this and the continued degeneration will serve to explain the subsequent steps of the disorder. Such a view is as plausible as many others offered, and may, perhaps, be more acceptable as a theory to the minds of those who give cre-

dence to the doctrine of cellular pathology, or, in other words, believe that all material taken from the blood is a result of the elective action of cells—that the material thus taken and assimilated by cell action tends to the nutrition and development of tissues and organs, while that which for any cause is imperfectly assimilated, results in such material as constitutes tuberculous or cancerous deposits, or the metamorphosis of pre-existing normal cells into those seen in either cancer or tubercle.

This brief summary of the chief facts of tuberculosis and deposits of tubercle must here suffice, and the student is referred for further details to the works on general pathology. Nor is it proposed to present anything like a full account of the surgical disorders which arise from deposits of tubercle, as deposits of *tubercle* in the *bones* will be treated of in connection with the diseases of the bones, and *tuberculous deposits in the testicle*, in connection with the diseases of that organ. A sketch of the history and treatment of *tuberculous deposits* in the superficial lymphatic glands, or, as they may be designated, *tuberculous*, *scrofulous*, or *lymphatic tumors*, will suffice for our present purpose.

**External Tuberculous Deposits.**—The lymphatic glands are, in children at least, more frequently the seat of deposits of tubercle than the lungs themselves, and though in the adult, tubercle is more frequent in the lungs, yet upon the whole, perhaps, it will be safe to say that the favorite seat of tubercle is in the lymphatic glands. Any of these glands may be affected; but leaving the consideration of those cases in which they affect internal glands, as the mesenteric or the bronchial, to the physician, allusion will here be made only to those cases in which the superficial glands are affected. Of these, the glands of the neck are most frequently attacked, though the axillary glands or those of the groin may suffer. The tuberculous deposit may be limited to a single gland, or, as very frequently happens, several may be affected. The tuberculous gland is more or less enlarged, and forms a smooth, indolent tumor, which at first is not painful or tender on pressure, and over which the skin preserves for a time its natural appearance. The deposit induces enlargement of the gland, which thus varies in size, from a small kernel, just perceptible to the touch, to masses the size of the fist, or of a child's head. In the larger tumors, which are seldom observed except in the cervical region, several glands are always affected, and the growth is then lobulated, each lobule consisting, as a general rule, of a separate gland.

The tumor may remain in this indolent condition for weeks, months, or even years, without undergoing any remarkable change; or after a time it may gradually diminish in size and disappear spontaneously, or in consequence of appropriate treatment. But in very many cases inflammation is developed about the affected gland, and this, in connection with the softening of the tuberculous deposit by the process above described, converts the tumor into a chronic abscess. While these changes progress, the skin covering the gland becomes red and tender, assuming often a peculiar livid appearance, which is quite characteristic. It then ulcerates, and the abscess discharges itself through the ulcer, which sometimes enlarges until a considerable portion of integument is destroyed.

While one gland is running this course, other deposits may develop in other glands and pursue a similar history.

The cicatrix left after the healing of such an ulcer is generally thick and puckered, like the cicatrix of a burn, produces considerable deformity, and is recognizable as due to tuberculous abscesses.

**Anatomy.**—The tubercular matter found in post-mortem examinations in the superficial lymphatic glands is generally of the yellow variety. It is well described by Mr. Paget as forming "roundish or irregular deposits of

yellowish, opaque, half dry, cheesy, crumbling substance." The history of its minute structure and of the metamorphosis which it may undergo does not differ in any essential particular from what has been presented previously as the general history of yellow tubercle. It must not, however, be supposed that every indolent enlargement of the lymphatic glands is due to tuberculous deposits. A chronic inflammation without deposit of tubercle, but accompanied by fibrinous deposits in the connective tissue, in the gland, or between its lobules, may produce external symptoms which are very similar.

**Diagnosis.**—Tuberculous deposits in glands must be carefully distinguished from several other disorders which produce enlargement of these lymphatic glands. The rapid progress of *acute* inflammation will readily enable the observer to make a diagnosis. But it is difficult, if not impossible, in very many cases at least, to distinguish between an enlargement due to chronic inflammation of the gland and hypertrophy, which is elsewhere designated as Adenoma, and that produced by deposit of tubercle.

Cancerous deposits on the lymphatic glands, when a primary affection, may also be confounded with the scrofulous tumor; yet a diagnosis is highly important, especially as influencing the prognosis.

Scirrhus, which is the most frequent form of cancer of the lymphatic glands, may sometimes be distinguished by its stony hardness, and by the lancinating pain of which it is the seat; but in many cases a positive diagnosis cannot be made until the cancerous affection has progressed to a formidable extent.

**Prognosis.**—Tuberculous deposits in the external lymphatic glands are seldom of themselves alone a cause of death, though the exhaustion produced by the discharge from the chronic abscesses in which they are apt to terminate may occasionally prove fatal. But the same constitutional peculiarities which led to their formation may lead to deposits of tubercle in internal organs, as the mesenteric glands, the membranes of the brain, the lungs, etc., which may terminate fatally. Or the debility and anæmia which have been mentioned as characteristic of the progress of tuberculous disorders may render the little patient less able to resist the various other disorders of childhood.

Nevertheless, if there is reason to believe that the external deposits are unaccompanied by deposits in internal organs, a *favorable* prognosis may generally be expressed, provided that the patient is so situated as to be able to employ the appropriate hygienic and medicinal modes of treatment.

**Treatment.**—The treatment of tuberculous tumors must be both general and local, being based on the principle of improving the general and local nutrition, and *preventing the cessation of cell development*—a fact which seems to be proved in all cases of tubercles, let it be explained as it may. With this view every effort should be directed to the improvement of the digestive powers, in order that by improved assimilation an increased amount of nutritive material may be introduced into the blood; hence, animal oils or liquid substances easily convertible into chyle; chalybeates and fresh air to augment the richness of the red corpuscles; exercise and tonics to augment the action of the nutritive organs, are essential; while the local nutrition or cell action should be augmented by local stimulants, the increased flow of blood and augmented cell irritability developed by counter-irritants, in parts adjacent to the seat of the deposit, being highly beneficial. In the tuberculous deposit seen in the lymphatic glands of the neck and elsewhere, the surgeon will usually find it beneficial to stimulate the skin by the application of iodine, or by flying blisters, that is, those applied to one spot after another, or frequently repeated at short intervals and for short periods; or by liniments and ointments; while cod-liver oil, animal fats, (as the fat of mutton, beef, etc.,) bitter extracts, laxatives, and all the means

usually employed to favor the action of the digestive organs, should be freely resorted to. When the tubercular deposits in glands or in bones soften and suppurate, the early evacuation of the pus and the gentle stimulation of the part will expedite the cure.

## CHAPTER II.

### THE VENEREAL DISEASE.

A PECULIAR perversion of local cell action, characterized by the production of serum, fibrin, and a specific pus, which is capable of modifying the general nutritive action of the economy, has been long recognized by surgeons, in consequence of the cause that first developed it, as the Venereal Disease or Syphilis, from the Greek words συς, a hog, and φιλυς, love; or from σιπαλυς, shameful, or dirty.

Under this general name writers have long included two distinct forms of disease, each characterized by modified action in the tissues at first involved. In the first, the mucous membranes of the genito-urinary apparatus are affected, and give rise to an increased discharge from these passages, mingled with pus, and accompanied with the ordinary symptoms and results of inflammation in mucous tissues elsewhere, which is known as **Gonorrhœa**; while in the second there is a perverted local action that leads to suppuration and ulceration in some part of the organs, this being strictly designated as **Syphilis**. To the ulceration, which is the starting-point of the infection of the system in this latter disorder, the name of **Chancre** or Primary ulcer or sore is applied; the transmission of the morbid matter from this chancre through the connective tissue cells and the lymphatics of the part into the general circulation giving rise subsequently to various constitutional symptoms which are noted in affections of the skin and mucous membranes, and designated as **Secondary Syphilis**, while the disorders of the bones and ligaments are known as **Tertiary Syphilis**, Gonorrhœa being a purely local inflammation, and in reality only a marked urethritis or vaginitis.

**Origin of Syphilis.**—The origin of the venereal disease was certainly impure sexual intercourse, and the period of the world's history at which it first appeared, having been long and freely discussed by surgical writers, is worthy of a brief reference, especially as it will show to the young American student that neither the discovery of America by Columbus in 1492, nor the siege of Naples by Charles VIII. of France in 1498, could have originated this disorder. That the disease brought back by the followers of Columbus from the West Indies was without doubt that which still occurs there, and is known as the Yaws or Frambœsia, is a point now regarded by many as settled, while it is more than probable that the soldiers of Charles VIII. only contracted, as the result of the unbounded license and disorderly life of the camp, an exaggerated form of a disease which previously existed. That the venereal disease undoubtedly followed close upon the licentious habits of men at an early period of the history of our race, is also believed by many to be proved by some of the allusions to the habits of the Israelites as made in Leviticus, where the rules of cleanliness are laid down and distinctions drawn between gonorrhœa and other results of the sins of the flesh. In the 32d verse, xv. chapter,* it is said, "this is the law of

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* Vulgate.

purification applicable to one who has a gonorrhœa, and also that of a person who has an issue of semen," thus directly making a distinction, and showing that the disorder was recognized as different from seminal emissions.

As violations of natural laws are always followed by disease, it is not improbable that during the earlier periods of the human race this complaint was originated by vicious intercourse between man and beast, to which allusion is also made by Moses, or arose from the frequent intercourse of one man with several women, which, with filthy habits and a warm climate, would doubtless prove sufficient for the creation of the disorder.

But without discussing the signification assigned by able commentators to the expressions of the laws of the ancient Jews, there is yet evidence of the existence of syphilis in England and elsewhere, long before 1492—Hippocrates, 460 B.C., and Celsus, who was the contemporary of Horace, Virgil, and Ovid, describing the disease, and giving many details of treatment which are noted as existing even at the present day.

In the Acta Sanctorum, as quoted by Sir A. Cooper, in his Lectures, by Lee, vol. iii. p. 19, it is stated that two cases were published in Great Britain in the year 1010.

The disease is also, he says, mentioned by Bernard Gordon, Professor of Medicine at the University of Montpellier, in a work, "De Passionibus Virgæ," published in 1305.

In 1320, Dr. Gaddesden, of Oxford, published a work which he entitled "Rosa Anglica," in which ulcers on the penis arising from sexual intercourse are described.

In 1347, brothels were established in Avignon, under Queen Jane, and certain laws or regulations laid down for their management. Among these will be found rules that are still extant in Paris, though in a modified form.

Some of these laws were very singular, and may be here repeated, as giving an idea of the sentiments upon this subject in those old times, rude and barbarous as they were, while showing that, even at this early period, legislation to restrict the evil, if it could not be checked, was deemed advisable by the crown.

Thus the wenches were limited in their walks, and were to wear upon their shoulder a red knot, by means of which they could readily be known.

The third rule states: "Our good Queen Jane doth further order that a brothel shall be located near the convent of the Augustine friars, and that no youth be admitted therein without permission first obtained from the abbess, or governess, who is to keep the keys, and counsel and advise them not to make a noise, or to frighten the wenches, which, if they disobey, they shall be laid under confinement by the beadles."

The fourth rule clearly shows the existence of disease in those times, as it orders that once a week the wenches be examined by the abbess in company with a surgeon appointed by the directors, and those that are diseased separated from the rest, "lest the youths should catch their distempers."

The Stews, in Southwark, London, had laws that date back as far as 1162, in the reign of Henry II.; these laws being modified by Edward III. in 1345. These Stews were destroyed by Wat Tyler's mob in the time of Richard II. They reappeared, however, and in the reign of Henry VI. were some eighteen in number, when they were again suppressed in 1546.

As this brief allusion to these old laws shows that the venereal disease existed many years prior to the discovery of America, the history of syphilis may be left to the more minute investigation of those who are specially interested in it.*

* The reader will find many other curious historical facts connected with this subject by referring to the Lectures of Lawrence, Cooper, and others among the English surgeons.

## SECTION I.

### GONORRHŒA.

**Gonorrhœa** is the name given to an inflammation of the lining membrane of the urethra of the male, and of the vagina and urethra of the female, resulting from impure coition, and exhibiting the symptoms of urethritis or vaginitis in a marked form.   In gonorrhœa the effects and characters of the inflammation are strictly analogous to those of inflammation as seen in other mucous tissues, and are to be treated and will be relieved by the same measures, based on general principles, as would be applicable to an inflammation of any other mucous membrane.

This inflammation gives rise to a purulent discharge from the urethra of the male, or the vagina of the female, and may follow any urethral irritation, though it is almost invariably the result of impure sexual congress, and is then of a more violent character.   The derivation of the term shows some of the very erroneous notions that were entertained respecting this complaint in early times, being from two Greek words, γονη, sperm, and ρεω, to flow, it being regarded as connected with the secretion of the testicles.   The purulent urethral discharge, the occasional result of the introduction of instruments that irritate the urethra, has been sometimes spoken of as **Benignant Gonorrhœa,** but it is best to limit the term Gonorrhœa to that discharge consequent on the irritation of an impure connection.

**Synonyms.** — Gonorrhœa has had various synonyms, such as **Blennorrhagia,** and **Blennorrhœa,** from βλεννα, mucus, and ρεω, I flow, which is an equally erroneous term, for the disease does not consist of a flow of mucus, as this term would indicate.   The English name for the complaint, **Clap,** is derived from the French word **Clapier,** a name applied to brothels in France, and was intended to designate it as the disease contracted in brothels.   The French term **Chaudepisse** is derived from the fact that there is usually more or less sensation of scalding in urinating, or *ardor urinæ,* as it is termed, at the commencement of the disorder.   The disease is also spoken of as *a running,* and as *the secret disease;* the latter term being equally applicable to syphilis.

**Complications.**—Some of the complications of the disease demand especial attention, and have received particular names.   Thus, we have **Balanitis**—βαλανος, glans—a term applied to an inflamed condition of the mucous membrane of the head of the penis and prepuce, resulting in a purulent or muco-purulent discharge, this being also sometimes called an *external clap.*

The inflammation of gonorrhœa sometimes affects the prepuce so that it swells to such a degree as to prevent it from being retracted, so as to uncover the glans, this condition being called **phymosis,** Fig. 157 ; the same condition is also a congenital malformation.   Sometimes the skin is retracted behind the glans, when the swelling of the mucous membrane takes place to such a degree as to prevent the prepuce from being brought down over the head of the penis—a condition known as **paraphymosis,** and, like phymosis, also sometimes due to other causes, Fig. 158.*

**Pathology.**—In order to understand the pathology of gonorrhœa, it should be remembered that the glans penis is covered by a mucous membrane, which, after lining the prepuce, is reflected over the head of the penis, and enters

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* For an account of the treatment of Phymosis, whether congenital or acquired, see vol. ii., under the head of Operations on the Genito-Urinary Organs of the Male.

the urethra, whence it is continuous with the lining membrane of the bladder and of the ureters.

In the urethral mucous membrane are to be found a considerable number of follicles, which, when inflamed, are capable of pouring out a large amount of fluid, and may continue in a state of inflammation even after the surface of the mucous membrane itself has taken on healthy action. These
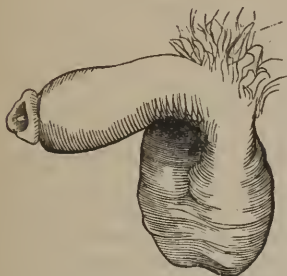
Fig. 157.                                           Fig. 158.
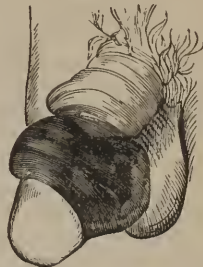
Fig. 157.—A side view of the manner in which the Prepuce covers the Penis in either Congenital or Acquired Phymosis.
Fig. 158.—A view of Paraphymosis, the dark portion being the mucous membrane which lines the prepuce, and which is distended by serous infiltration of the submucous cellular tissue.

follicles also sometimes become enlarged, and, continuing inflamed, induce a deposit or thickening of the adjacent tissues, thus creating a tendency to stricture of the urethra. When inflammatory action commences in the urethra, we have first congestion and tumefaction of the membrane, then serum and increased mucous secretions, and then pus, ichor or sanies, or all mixed; the portion first inflamed furnishing pus, while the deeper parts of the urethra, being only congested, furnish serum. The inflammation being progressive from the orifice of the urethra to the bladder, the symptoms will correspond with its extent and degree, the inflamed follicles often continuing to furnish a drop of pus, as in gleet, when the rest of the urethral membrane has recovered its usual action.

**Etiology.**—As the sole origin of gonorrhœa is an impure connection, (notwithstanding that many other sources are often charged with it by patients,) it is evident that the male becomes infected by the discharge which collects upon the rugæ of the mucous membrane of the vagina in the female—this being wiped off by the penis as it enters in a connection, or rather pushed into the orifice of the urethra, the tension of the parts distending its aperture so that some of the matter is permitted to lodge within the fossa navicularis. This matter, if at all virulent, is quite sufficient to excite in a short time a purulent discharge from the whole of the canal; the inflammatory action, unless checked, extending itself, in a few days or weeks, throughout the entire canal.

**Symptoms.**—The symptoms of gonorrhœa are purely those of an inflammation of a mucous membrane, and vary from day to day, in accordance with its extension. They are as follows: in from three to six or eight days—though sometimes only a few hours may elapse—after an impure connection the patient begins to experience a sense of tickling or tingling at the orifice of the urethra, the result of congestion of the membrane. On examining the parts, the lips of the urethra will now be found to be slightly swelled and inflamed, while the attempt to make water will create that peculiar sense of burning and smarting to which the name of *ardor urinæ* has been applied, owing to the increase of sensibility that generally accompanies inflammation

anywhere.   After a few hours, the part is moistened with a slight color-
less discharge, which consists of serum mixed with the ordinary mucous
secretion of the urethra; but in a very short time this discharge becomes
more or less yellow, from the admixture of pus.   In a few hours more,
true yellow pus will be effused, while, as the inflammation attains a higher
grade, there may be noted all the modifications of pus seen in other inflam-
mations, as ichor or sanies, the discharge being green, or pinkish, and
sometimes streaked with blood, from a rupture of some of the congested
vessels of the lining membrane of the urethra.   As the disease progresses,
effusions of lymph often take place into the submucous areolar tissue, and
into the corpus spongiosum directly beneath the urethra, while the constant
afflux of blood to the corpora cavernosa gives rise to frequent and violent
erections of the penis, though the organ does not become completely erect
as in health, but is bent downward, in consequence of the inflamed mucous
membrane of the urethra acting as a string to a bow.   To this condition the
term *chordee* has been applied—from the Latin word *chorda*, a string.

Chordee may be present at any period of an attack of gonorrhœa, though
it seldom takes place in a marked degree until the inflammatory action has
resulted in the secretion of pus, and there has been an opportunity for the
thickening of the submucous areolar tissue of the urethra.   There is usually
considerable pain accompanying chordee, this being due to the extension of
the inflamed mucous membrane, caused by the distention of the corpora
cavernosa acting on the corpus spongiosum urethræ.

The progress of the inflammation is now apt to be seen in its attacking
the lymphatics of the penis, thus occasioning a sense of inconvenience and
fullness, if not of actual pain in the body of the organ, and as the irritation
extends from these lymphatics to the glands of the groin, heaviness and
soreness are complained of in this region, as well as a sense of weight in
the perineum or in the testicles, though the latter is not generally felt until
the end of the third or fourth week, the enlargement of the testicles being the
result of the extension of the inflammation from the urethra through the
orifice of the ductus ejaculatorius, thence along the vas deferens to the
epididymis, and this seldom occurring before the end of the third week.

Should the inflammation continue and rise in grade, we may next notice
its extension to the deeper-seated parts adjacent to the urethra, where it
may be shown in deposits of fibrin in the submucous areolar tissue, thus
creating stricture of the urethra at a later period, or abscesses of the pros-
tate, cystitis, or even nephritis.

Diagnosis.—There are two forms of gonorrhœa, one of which is the *viru-
lent* or true gonorrhœa, and the other the *benignant* or false gonorrhœa;
the secretion of the menses, particularly if mixed with acrid fluor albus, or
violent leucorrhœa, sometimes exciting a secretion of pus from the urethra
of a delicate man if brought in contact with it in coition.   Though the latter
inflammation resembles the other, it differs in the violence of its symptoms
as well as in its grade, and is therefore also designated as *spurious gonor-
rhœa*.   The same condition has sometimes resulted from the irritation
created by the introduction of a bougie.   True gonorrhœa, or the virulent
form of urethritis, only ensues on intercourse with a person who is at the
time laboring under a similar purulent disorder.

The best aid in the diagnosis between the mild and virulent form of urethri-
tis is the color of the discharge, which, as true gonorrhœa is a higher grade
of inflammation than the spurious, is usually deep yellow, greenish, or pink-
ish in its tint, while that of the spurious form is white or yellowish.   The
ardor urinæ, chordee, tendency to epididymitis, etc. also give evidence of
the presence of a grade of mucous inflammation in true gonorrhœa which

is seldom if ever seen in the spurious disorder, the inflammation in the latter case usually passing off in a few days, and creating little or no ardor urinæ.

**Prognosis.**—The prognosis in gonorrhœa will depend upon circumstances. If the patient presents himself at the moment at which the swelling of the lips of the urethra and slight ardor urinæ are first noticed, he can often be cured in from three to five days. If, however, the disease has lasted for some days or weeks before he applies to the surgeon, and the inflammation has thus created considerable change in the tissue of the urethra and extended several inches into the canal, the discharge will generally continue from three to five or seven weeks, or even as long as two or three months, particularly if from time to time the patient is guilty of indiscretions in food and drink.

**Treatment.**—The treatment of gonorrhœa may be divided into three different stages: the prophylactic, the abortive, and the curative.

**1. Prophylactic Treatment.**—The best prophylactic measure is to abstain from exposure to the cause. But when the patient has had a suspicious connection, he may do something to prevent the development of gonorrhœa by washing thoroughly with soap and water, and urinating as soon as possible after the intercourse, in order to remove any irritating matter which may have collected in the urethra. The use of sheaths, etc., during coition, only tends to a false security.

**2. Abortive Treatment.**— Should the disease appear promptly, an abortive treatment may be resorted to under certain conditions; thus it is particularly applicable to the state of the parts found at the beginning of the complaint, when the thin serous discharge, or that resembling the white of an unboiled egg, first appears, and before inflammatory symptoms have developed themselves; in other words, during the first twenty-four or thirty-six hours of the disease. The abortive treatment consists in changing the action in the part, and substituting for the existing irritation or inflammation, which at this period has seldom progressed more than an inch into the canal from its orifice, one developed by means of the nitrate of silver, applied either in the solid form or the strong solution. If used in its solid form, Lallemand's instrument for cauterizing the urethra may be employed.* If the solution seems preferable, ten grains of the salt to an ounce of distilled water should be injected, once *by the surgeon himself*, with a glass syringe, care being taken not to bruise the orifice of the urethra with the instrument. When this solution is well injected, it should be retained in the canal a few minutes by grasping the end of the urethra and penis with the thumb and forefinger, after which it may be ejected by the patient making efforts as in urination. Before using this solution, the urethra should, however, be well washed out either by the patient urinating or by the surgeon injecting tepid water. The injection of the nitrate of silver, as thus practiced, creates considerable pain, and acts by forming a white pellicle over the inflamed surface, which protects it from the irritation of the urine for the next twelve or twenty-four hours, while in the mean time it sets up a new and healthy inflammatory action. The next day the orifice of the urethra will be found more swollen, and the discharge probably more copious and pinkish than it was previously, or it may even be streaked with blood, and the patient should be forewarned of this fact, to prevent alarm and discontent. An injection of sulphate of zinc and acetate of lead, from one to three grains of each, to the ounce of water, may now be ordered, to be used four or five times a day by the patient himself, the cure being generally effected

* See vol. ii.

in from three to five days, the patient abstaining from drinks of all kinds, in order to diminish the amount secreted by the kidneys, though he may take his usual food in a limited amount.    The abortive treatment is, however, very seldom applicable to an attack of gonorrhœa, because patients do not apply to a surgeon at a sufficiently early period, but wait until pus is seen in the discharge, when it is too late to employ it advantageously.    When resorted to at this time, there is always danger of inducing such a violent grade of inflammation as may result in sloughing of the urethra or the subsequent development of serious stricture of the canal.

**3. Curative Treatment.**—The curative treatment of gonorrhœa is that which is most frequently required, as it is applicable even to the highest inflammatory stage.    The indications to be observed are : first, to combat and check the unhealthy inflammatory action ; and, second, to relieve the weakness left in the tissue.    In carrying out the first indication, and attempting to check inflammatory action, antiphlogistic measures should be employed both locally and generally, especially by taking blood locally. Thus, if the inflammation runs high, we may commence by abstracting blood freely from the perineum by means of leeches applied between the anus and the scrotum, directing the application of enough to take six or eight ounces, while immediately afterward a free purge should be given.    After this such articles may be employed as, by impregnating the urine, and being thus brought in contact with the surface of the urethra, will alter its character, as well as act on the inflamed tissues.    These articles are to be found in the balsams and terebinthinates.    That they act by coming directly in contact with the urethra, is proved by the fact that patients with gonorrhœa, who labor also under fistula in perineo, in consequence of which the urine passes out without touching the diseased urethra, are not benefited by these internal remedies, while so soon as the fistula closes sufficiently to enable the urine to again pass through its proper canal, the patient begins to improve.

We may also employ locally the large class of astringents, with a view of checking the secretion.

Some of the prescriptions that may be advantageously resorted to in the administration of the terebinthinates are as follows, the combinations being such as to render them acceptable to the stomach.    Many of them were used in Ricord's and other hospitals of France, and have been long tested in my own practice.

The following is an old prescription, which I have employed very largely, and which I have given when the discharge was green and ichorous, and the ardor urinæ quite marked, without finding it too stimulating :—

> ℞.—Pulv. cubebæ, ℥ss;
> Bals. copaibæ, f℥ij;
> Ferri sulph. exsiccat. ʒj;
> Terebinth. Venetii, ʒiij.   M.

Divide into boluses of ten grains each, one to be taken three or five times daily.    As there is a difficulty in making this formula into pills, Canada balsam may be substituted for the Venice turpentine.    To give these pills proper consistence, the mass should be allowed to stand for fifteen days, and the pills be subsequently coated with balsam of Tolu.

If the patient who is to take balsam, etc. prefers the form of mixture to that of pill, the following may be given :—

> ℞.—Bals. copaibæ,
> Pulv. cubebæ, āā ℥j;
> Liq. potassæ, f℥ij;
> Pulv. accaciæ gum, ℥ss;
> Aquæ rosar. f℥vj.   M.
> S.  A tablespoonful may be taken three times a day.

The administration of the balsam in the form of capsules is also highly useful, though more liable to disorder the digestive organs.

The following formula has been so lauded by Ricord as to be called, in Paris, his favorite. It is particularly applicable to the weak and debilitated constitutions which are to be found in his wards, and which are also occasionally met with in our own cities, and especially in patients of the tuberculous diathesis :—

> ℞.—Pulv. cubebæ, ʒvj;
>     Ferri carb. ʒiij.
> M. et ft. pulv. dein in chart, iij, dividend.
> S. Take one powder three times a day.

Or the following :—

> ℞.—Potass. acetat. ʒiij;
>     Pul. rhei, ʒi;
>     Misturæ camph. f℥vss.    M.
> S. A tablespoonful every four hours.

I have sometimes given the acetate of potash, in half-drachm doses, every four hours, with advantage, especially where the urine was scanty and high colored, and evidently highly acid. Ficinus, of Dresden, praises the wine of colchicum, in thirty-drop doses, three times daily, combined with laudanum, a warm bath, and low diet.

The following formula, suggested by Mr. Hilton,* contains chlorate of potassa, which, it is lately thought, exercises a peculiar influence in these complaints, especially in modifying the action of the mucous membrane. It contains also a quantity of rhubarb, with a view of acting upon the bowels, and aiding the urethritis by the effects of purging :—

> ℞.—Pulv. rhei, ℥ss;
>     Liq. potas. f℥iss;
>     Potassæ chlorat. ʒiij;
>     Aq. menth. pip. f℥vj.    M.
> S. Take a tablespoonful two or three times a day.

In the early treatment of the gonorrhœa of high livers, whose diet, etc. have disordered their digestion, and created furred tongue, with highly acid urine, I have found this a useful combination.

*Injections.*—Besides these internal remedies, great benefit will be derived from the use of alterative and astringent substances, as injections, as soon as the first violence of the inflammation has subsided. In connection with the use of injections, it may be mentioned that much needless fear sometimes exists in the minds of patients, lest the injecting material should get into the bladder and cause cystitis; but, as a general rule, there is no danger of throwing an injection, into an inflamed urethra, any farther than the accelerator urinæ muscles or the bulb of the urethra, as the contraction of these muscles on the urethra will usually check its farther progress.

Fig. 159.



In order to use an injection properly, the patient should be directed to fill the syringe and insert its end gently within the urethra, closing the orifice around its point, as in Fig. 159. Then sitting down on the edge of a chair or bed, or upon a ball made by rolling up a

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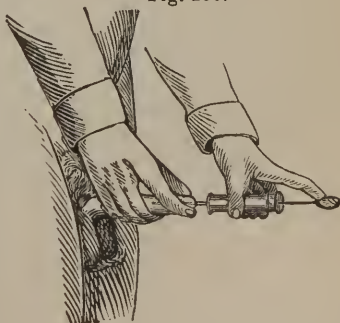
* New Way of Treating Gonorrhœa, by Jno. L. Hilton, M.R.C.S.   London, 1852.

handkerchief or stocking, so as to press upon the perineum, throw the fluid in by a motion of the piston, as shown in the figure, and, withdrawing the nozzle, close the urethra quickly and hold the injection for a few minutes; then repeat the operation twice or three times, as before. An attempt to urinate will evacuate the fluid without difficulty.

Injections between the prepuce and glans penis are often required in cases of phymosis. The only caution necessary to be given in these cases is to prevent the patient from introducing the syringe into the orifice of the urethra, instead of beneath the prepuce.

As the chordee not only creates pain, but also sometimes produces a permanent curvature of the penis, it not unfrequently—if the patient has had gonorrhœa for some time, or has had several attacks of it—leaves an effusion of lymph in the cells of the corpora cavernosa, which will subsequently prevent their proper distention.

To relieve chordee it will often be advisable to caution the patient, particularly if he be of an irritable disposition, against attempts at *breaking the erection* by bending the penis violently, as these efforts may do serious harm, and can certainly never give any relief; and as the chordee is due to an irritation of the urethra, the proper means for its relief are such as are suitable to the relief of irritation elsewhere. A very simple plan of treatment consists in directing the patient, as soon as he feels the erection, to spring out of bed and stand with his feet on a cold hearth; or to dip the penis and perineum into cold water by stooping over a basin; or to put his feet in the same, though the chordee will be very apt to recur as soon as he gets warm again in bed.

He should also be directed to sleep with very light bed covering, and to take a cold hip-bath at night, while two grains of camphor and one grain of opium may be given in a pill at bedtime, the camphor being useful by acting directly upon the urine, as well as affecting the cerebellum as a sedative. As there are, however, many persons who are unable, or who imagine they are unable, to swallow a pill, the same effects may be obtained by directing them to drop upon a lump of sugar forty drops of laudanum and twenty drops of the tincture of camphor, this being also preferable from its more rapid absorption. If the opium is for any reason contra-indicated, extract of hyoscyamus or conium, in two-grain doses, repeated every two or three hours, may be substituted for it; or lupulin, in the dose of one scruple, increased if necessary, will often prove serviceable.

In the treatment of gonorrhœa, it will be found that the anxiety with which the patient looks forward to his restoration to health often arises not so much from the pain and trouble that is present with the discharge or the pain of chordee, as it does from the fact that the stains made upon his linen are likely to lead to the discovery of the origin of his complaint. Even in those cases in which this is a matter of indifference, the soiling of the linen is unpleasant, and may readily be avoided by directing him to wear a proper sheath for the organ during the continuance of the disease. Such a sheath may be made—like a large finger-stall—of linen lined with oiled silk, or, still better, of India-rubber cloth, which, being attached to two tapes, and made to pass round his hips, may readily be drawn over the penis, so as to cover it entirely, and yet be slipped off for the purpose of urinating.

When warmth and moisture are required to be applied to the penis, a very convenient and cleanly mode of accomplishing it is by means of this sheath and patent lint, the latter being moistened with hot water, before it is wrapped lightly around the penis.

During the whole course of the treatment of gonorrhœa, the patient should also be directed to wear a suspensory bandage, in order to guard against congestion of the scrotum, and epididymitis or swelled testicle.

There are various forms of astringent and alterative injections that prove useful in the treatment of gonorrhœa; thus, after the action of the membrane has been changed by the abortive plan of treatment, we may not only use the sulphate of zinc as already recommended, but acetate of lead may be substituted for it, or the two may be used together in the proportion of one grain of each to the ounce of water. In fact, any of the mineral astringents may be employed in the proportion of one or two grains to the ounce of water, except the sulphate of copper, which should never be used stronger, at first, than half a grain to the ounce. The tannate of alumina, five grains to the ounce of water, is also a valuable combination.

There are several combinations of these articles which are very useful in cases where the discharge has lasted some time, or in patients in whom the abortive treatment has not been employed, as will be subsequently stated.

The idea formerly prevalent, that it is necessary to wait till the inflammatory stage of the disease has entirely passed away before resorting to the use of stimulating injections, has, however, been exploded by numerous observations, and my own plan of treatment is to employ injections in all cases of private patients where the ardor urinæ is not very marked.

It sometimes happens, however, that a patient will suffer extreme pain from their use, or that he cannot immediately bear the repetition of them, particularly after the abortive injection of the nitrate of silver has been employed; and under these circumstances much comfort will be obtained from first resorting to the following injections:—

R.—Muc. sem. lini, Oj;
Pulvis opii, grs. x. M.
S. Inject as often as may be necessary to diminish the irritation.

Another injection, which is exceedingly useful in patients who suffer from chordee, contains camphor, and is as follows:—

R.—Pulv. camphoræ, ʒss;
Vitellum ovi, j;
Aquæ fontan. Oj. M.
S. Inject frequently.

Should this not relieve the ardor urinæ and chordee, the following may be substituted:—

R.—Pulv. opii, grs. xij;
Aq. font. f℥ix;
Liq. plumb. subacet. gtt. ix.
Misce.

This should be well shaken before being injected, and is an excellent sedative and slightly astringent injection.

A formula for which I am indebted to Dr. Bird, of Philadelphia, though a singular compound, is one that often modifies the inflammatory action and cures promptly. It is best to resort to it at an early period of the disorder:—

R.—Quiniæ sulphatis, Əss;
Elix. vit. gtt. xvi;
Ess. ol. camphoræ, gtt. j;
Liq. ferri iodid. gtt. vi;
Aquæ distil. f℥ij.
Misce.
S. Inject one syringeful every four or five hours.

Dallas, of Odessa, has recommended the following:—

R.—Bals. copaib. f℥v;
    Vitel. ovi, j;
    Ext. opii, gr. j;
    Aquæ, f℥vii.
Misce.
S. Inject several times daily.

The following formula, recommended by Gambarini, of Bologna, Italy, has been repeatedly employed by me with much advantage, even in acute cases:—

R.—Tinct. aloes, f℥iv;
    Aquæ, f℥iv.
Misce.
S. Inject two syringefuls twice daily for a few days.

Should the disease, from want of proper treatment, have continued for several weeks, certain sequelæ will be likely to appear and require attention. Thus the inflammation may travel down to the bulb of the urethra, and thence to the caput gallinaginis and along the ductus ejaculatorius and the vas deferens to the epididymis, so as to create Epididymitis. Or, traveling still further, it may produce inflammation and abscess of the prostate, or even invade the mucous coat of the bladder and create cystitis; or it may become chronic, and thus develop gleet.

## ₰ 1.—Epididymitis.

**Synonyms.**—Epididymitis has several synonyms: thus it was called by the old surgeons *hernia humoralis* and *orchitis;* while, by the people, it is known as *swelled testicle.* The term epididymitis, which is strictly correct, although the inflammation may extend from the epididymis to the testicle itself, indicates the true condition of these parts when consequent on an attack of gonorrhœa.

**Etiology.**—Epididymitis may result from other causes, as the irritation of a bougie, as well as from gonorrhœa, though the latter is its most common source. When consequent upon gonorrhœa it usually shows itself as follows:

**Symptoms.**—About the third, fourth, or fifth week, the patient notices a cessation or diminution of the discharge from the urethra, and at the same time begins to perceive a slight sensation of weight in the groin, and on pressing upon the cord finds it to be slightly swelled and painful, thus showing the extension of the inflammation along the vas deferens. These feelings of uneasiness being then propagated along the back of the cord toward the testis, produce heaviness in the scrotum and groin, and are soon followed by swelling of the epididymis, the globus major and minor beginning to enlarge and continuing to do so until they are sufficiently increased to cover the whole testicle. As the inflammation progresses it may extend to the tunica vaginalis testis, and produce true hydrocele, or to the scrotum, and produce œdema or inflammatory congestion; or, as previously stated, it may involve the tunica albuginea and the proper structure of the testis itself, though the last is very rare. The symptoms of epididymitis, if sufficiently violent to create constitutional disturbance, will also give rise to those of irritative or inflammatory fever. As the discharge from the urethra generally diminishes before the swelling in the testicle is noticed—owing to the metastasis of the inflammatory action—the idea was formerly held, and is still believed in by the vulgar, that the discharge causes the swelling; and hence we often hear the expression that "the clap has fallen into the testicles."

**Diagnosis.**—In regard to the diagnosis of epididymitis there is usually but little difficulty in arriving at a correct conclusion, the history of the case

and the accompanying symptoms referring the disorder to its true source. Should, however, the patient be disposed to deny the origin of the complaint, a very few days, by bringing back the discharge from the urethra, will add considerably to the facility of diagnosis.

**Prognosis.**—The prognosis of epididymitis is favorable, and under ordinary circumstances a cure may be expected in about nine days.

**Treatment.**—The treatment of epididymitis is based upon the general principles of the treatment of inflammation elsewhere; thus leeches should be at once applied to the cord or to the perineum, but *not to the scrotum*, where their irritation would only increase the existing inflammation.  For the first three days the patient should also be kept in the recumbent position, with the testicle well supported by a handkerchief suspensory, (see Fig. 114, page 159,) in order to prevent it from drawing upon the cord.  At the same time warm cloths should be applied, and covered with oiled silk, as in the warm water-dressing; or, if it is more agreeable to the feelings of the patient, the cold water-dressing may be used.  Then, after twenty-four or forty-eight hours, or when the first violence of the inflammatory action has passed, means may be employed to relieve the parts of the effusions which ensue on the inflammatory action, and this may be accomplished by continuous and firm pressure of the affected testis, a plan first suggested by the late Dr. Joseph Hartshorne, of Philadelphia, who, as early as the year 1800, applied it by means of a narrow bandage.

About the year 1835, Frick, of Hamburg, recommended that the pressure should be made in these cases by means of strips of adhesive plaster, and suggested a firm and easily contrived dressing, which may be applied as follows: Shave the scrotum entirely free from hair, and force the testicle gently down to the bottom of it, where it should be held by surrounding the cord just above the testicle with the thumb and forefinger of the patient or an assistant.  A strip of adhesive plaster about three-fourths of an inch wide being now warmed, should then be made to surround the cord just below the thumb and finger, and when thus applied, will hold the testicle firmly to the bottom of the scrotum and prevent it from slipping away from the compression to which it is subsequently to be subjected.  After thus steadying the testicle, begin in the centre of the oval tumor thus formed, and surround it with circular strips so tightly drawn that the patient will complain a little of the pain, and continue applying other circular strips from below upward till the lower half of the tumor is covered, each strip being made to lap one-third of that which preceded it; after which cover in the remaining half in the same manner, while the small part at the bottom of the tumor, necessarily left uncovered by the circular strips, may be covered, and greater security given to the dressing by applying a few vertical pieces of the plaster, Fig. 160.  These strips, if properly applied, should cause sufficient compression to create some pain at the moment of their application, but this usually passes off in an hour, and in the course of six, eight, or ten hours the dressing will be found quite loose, and no longer painful, but, on the contrary, firm and comfortable. In forty-eight hours, as the swelling will have rapidly diminished, the strips should be tightened by applying over the whole dressing a few more broad and circular pieces of the plaster; in three or four days more the whole dressing may be removed, when the testicle will be found to be reduced very nearly to its former condition, except the thickening in the globus major, which will be no longer painful.

Fig. 160.



Under this treatment the swelling will generally rapidly disappear, and the
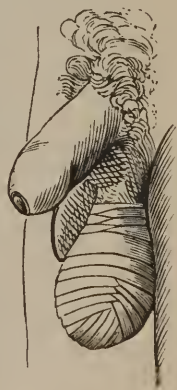
patient be often able to move about to a moderate extent within twenty-four hours after the application of the strips.

Sometimes, however, there remains a certain amount of enlargement in the globus major, from the effusion and organization of the lymph, which will leave an induration that will last some months.    Sometimes, also, the tunica vaginalis testis will continue slightly indurated, from the fibrin deposited throughout its cavity, thus constituting one form of the old sarcocele, or, as it has been designated, chronic orchitis.    In such a condition the plan pointed out for the treatment of chronic inflammation, and induration of other structures, will be useful, such as stimulating the action of the vessels by local irritants.    Thus the use of iodine will be found highly beneficial, iodine ointment being rubbed upon the scrotum, after which the part may be covered with a piece of soap plaster and the whole sustained by a suspensory bandage; or frictions of mild mercurial ointment may be resorted to, care, however, being taken to carry none of these applications to such an extent as to inflame the skin, as this would only add to the existing congestion instead of diminishing it.

At the same time the administration of gentle doses of blue mass or calomel, or of the iodide of potassium as alteratives, will often expedite the cure.

Sometimes, from improper treatment or neglect in the first instance, the inflammatory action results in a true abscess of the testicle, which will subsequently open and discharge itself, or which the surgeon may open.    But if he notices, in the orifice thus made for the escape of the pus, a white thready matter which looks like a slough, he should remember that this may be a portion of the rete testis, which, if pulled upon, will come away in long shreds, and, thus destroying the structure of the organ, leave the patient completely emasculated, so far as that testicle is concerned.    The general rule, therefore, is, that in any abscess about the testicle, all suspicious-looking shreds of matter should be left untouched until fully thrown off by nature.

The hydrocele resulting from epididymitis, as already mentioned, if it do not disappear on the cure of the inflammation, will demand precisely the same treatment as hydrocele resulting from any other cause.

## § 2.—Gleet.

From improper treatment, or as a result of indiscretions on the part of the patient while laboring under an attack of gonorrhœa, it often happens that the disease is imperfectly cured, and the inflammatory action not subdued, or that the inflammation continues to affect the action of one or more of the muciparous follicles of the urethra, in consequence of which a slight discharge remains, which shows itself in the shape of a drop at the mouth of the urethra when the patient rises in the morning, or is seen subsequently through the day. This condition has been designated as **Gleet,** and occasionally as **pin-head gleet,** in order to indicate the size of the drop of matter found at the orifice of the urethra.    Occasionally this slight discharge is due to the formation of a stricture.    In every case, however, it may be taken for granted that there can be no discharge of pus from the urethra, without there being some inflamed or ulcerated surface from which it proceeds.

Under these circumstances a bougie should be introduced for the purpose of ascertaining whether any stricture exists, and, as the introduction of the instrument causes a slight stimulation of the membrane, it alone will often suffice for the relief of the complaint.    Should a stricture be detected, it is to be treated in the manner that will be detailed under the head of Stric-

ture. If, however, the examination shows that there is no stricture, a bougie smeared with an ointment of nitrate of silver, grs. x to ℥j, may be introduced to the suspected point, or a stimulating injection of nitrate of silver may be used with the view of modifying the chronically-inflamed condition of the parts, and substituting for it an acute but more tractable inflammation, which will readily yield to treatment. In other words, gleet is to be treated on precisely the same general principles as a chronic inflammation elsewhere. Several formulæ for such injections may be given for the sake of illustration:—

R.—Vin. oport. f℥iv;
Acid tannic. ℈j. M.
S. Inject three times daily.

Another good injection, in cases dependent upon simple debility, is the following:—

R.—Decoct. cinchonæ, f℥viij;
Liq. plumb. subacet. f℥j. M.
S. Inject three times daily.

Another injection, which is particularly useful when a spot that is tender upon pressure can be found by carrying the finger on the outside of the penis along the course of the urethra, is as follows:—

R.—Hyd. chlor. mit. ℨss;
Muc. gum acaciæ, f℥xij. M.
S. Inject twice daily.

The following is particularly applicable to patients who are debilitated, or of a scrofulous habit:—

R.—Tr. iodini, gtt. xxx;
Muc. gum acac. f℥ij;
Aq. font. f℥vi. M.
S. Inject twice daily.

The following is useful in the case of old stagers:—

R.—Vin. aromat. f℥xiij;*
Acid. tannic. ℈ij;
Ext. opii aquos. ℨss. M.
S. Inject three times a day.

Where many attacks of gonorrhœa have been experienced, the following may be borne by patients whose urethra have become indurated, and has been recommended by Gaudroit:—

R.—Zinci chloridi, grs. viij;
Aq. font. f℥viij. M.
S. Inject once daily, for two or three days, but not far into the urethra.

§ 3.—**Prostatitis.**

Another result of long-continued gonorrhœa is acute inflammation of the prostate, or **prostatitis**.

**Symptoms.**—A sense of weight is experienced in the perineum, and, on passing the finger into the rectum, an enlargement of the prostate can be distinctly felt. Prostatitis generally involves the two lateral lobes of the gland, and, when abscesses form, they are usually found in this situation;

* Of the French Codex. For formula, see p. 261.

but the third lobe also not unfrequently enlarges, and that to such an extent as to obstruct the flow of urine, though this often exists without being in any way due to gonorrhœa.    The period of the formation of pus is gener- ally marked by distinct evidences of constitutional disturbance, as a chill, high fever, etc.

**Treatment.**—The treatment of acute prostatitis consists in applying leeches to the perineum; in the use of the warm hip-bath, and in the gentle employ- ment of laxatives to keep the bowels in a soluble condition; but purgatives, particularly aloetic purges, should be avoided, as they are only likely to add to the local irritation.  If abscesses form they must be left to nature, as they seldom point in the perineum, owing to the relations of the deep perineal fascia; hence they are apt either to open into the urethra, or to form rectal, perineal, or urethral fistula.

Should the enlargement of the third lobe of the prostate prevent the free evacuation of the urine—a condition generally due to hypertrophy, and most frequently seen in advanced life—the use of a catheter will be demanded, as will be shown under the head of Retention of Urine.

### § 4.—Stricture of the Urethra.

Another complaint, frequently a sequel of gonorrhœa, but occasionally arising from other causes, is the obstruction of the canal of the urethra, resulting from the inflammation acting upon the submucous connective tis- sue, and leading to the deposit of fibrin.    This fibrin may simply involve the submucous connective tissue, or go further, and affect the corpus spongi- osum, or the corpora cavernosa, creating a change in the calibre of the canal that is designated as a *stricture*.    By the term stricture is usually meant such an obstruction of any of the canals in the body as is either the effect of inflammatory action or produced by spasm of the muscles, the latter creating such a contraction of the canal as will temporarily oblit- erate it.

**Varieties.**—Stricture of the urethra, for the purposes of methodical study, may be divided into three kinds.

1. **Spasmodic** stricture, or that arising from mere spasmodic contraction of the muscles of the penis or of the perineum.

2. Acute **inflammatory** stricture.

3. Chronic or **permanent** stricture, or that due to the products of inflam- mation, especially fibrin deposited in the adjacent tissues.

Permanent stricture has also been subdivided into several forms, according to its extent.    Thus, if the obstruction is extremely narrow, it is called a *thread-like* stricture; if a little wider, it is designated as a *ribbon-like* stric- ture; while the term *cartilaginous* is sometimes employed to indicate the density of the obstruction.

Permanent stricture of the urethra is not often seen until long after the exciting cause, if it be a gonorrhœa, has passed away.    It therefore not unfrequently shows itself in men, many years after they have suffered from gonorrhœa, because the morbid action in the urethra progresses so slowly that it is a long time after its commencement before it begins to attract attention.    When once formed, it is equally slow in being removed, and is very apt to reappear by the continuous contraction of the inodular tissue that is often the basis of the obstruction.

**Etiology of Stricture.**—1. *Of spasmodic stricture.*  When an individual has been living rather freely, indulging too much in eating and drinking, or has been to a ball, and partaken plentifully of stimulating articles of food or

drink, and then walked home through the snow, or has been on a sleighing party, or on a frolic, in either case, on his return home, or before he enters a house, he will often have a desire to urinate, and find it impossible to empty his bladder. The same condition is also found in certain fevers, and in accidents requiring the supine position, as fractures of the leg, etc., the patient frequently finding it difficult or impossible to void his urine for the first few days that he is confined on his back. This form of stricture is, therefore, entirely due to irregular nervous action connected with congestion of the spinal cord, or due to a spasm of the muscles, caused by reflex action from irritation of the urethra.

2. *An inflammatory stricture* is the result of irritation or inflammation in the urethra itself, which, by effusion, diminishes the calibre of the canal. It is frequently combined with paralysis of the muscles of the vesical triangle, a striking example of which is often seen in gonorrhœa, where, when the patient urinates and suffers intensely from ardor urinæ, he is induced to hold his urine as long as possible, until, when he again attempts to pass it, he finds he has lost the power of doing so.

3. *Permanent stricture* may be the result of repeated attacks of the spasmodic stricture, in consequence of the muscular fibres compressing the urethra, as is especially the case near the bulb; or it may ensue upon the inflammatory stricture, or on gonorrhœa, or blows, or ulceration, etc., which, by creating deposit of lymph in the submucous connective tissue, diminishes the capacity of the canal to the extent of the deposit. This lymph, which is originally formed as the product of inflammatory action, may subsequently become organized, and, passing through the various grades of induration, create a substance as dense as cartilage, and which cuts like it; hence an old stricture is often spoken of as the *cartilaginous stricture*.

As the permanent stricture is the most serious of these varieties, the symptoms, etc. of strictures may be best studied under this head.

### 1. *Permanent Stricture.*

**Symptoms.**—The symptoms of permanent stricture are as follows: The first thing that calls the patient's attention to the parts is the experience of some slight irregularity in the stream, or difficulty in urinating, or he may feel a certain amount of irritation at some one point which excites his attention; after which he will notice the presence of a slight muco-purulent discharge, which resembles that of pin-head gleet, and is often the origin of the latter disorder. As this discharge comes in contact with his linen it will make a stain, which is thick and somewhat like the spot caused by a little melted tallow. The urine itself, in certain conditions, is also capable of staining the linen; but this stain is a simple discoloration, while the stain produced by gonorrhœal matter, by gleet, by the discharge from stricture, and other purulent discharges not only produces a discoloration, but communicates to the linen a certain amount of stiffness. After this the desire for urination becomes more frequent, and is shown by the patient urinating once, twice, or thrice nightly, oftener than usual, and even more so during the day, while the evacuation of the bladder is not complete, being often unsatisfactory and creating more or less disposition to strain. The stream of urine is also irregular, being diminished in thickness, so that it may become as fine as a thin wire, while it not unfrequently takes a spiral direction, or becomes twisted and spatters as it escapes from the urethra. Owing to the varying calibre of the urethra at different points, and other irregularities in its size, the natural stream, it should be remembered, is itself always more or

less spiral; but in stricture it is positively irregular and often forked, the spiral twist being a short one, and the coils separate, like those in a cork-screw.

After urinating, the patient frequently finds that he has not entirely emptied his urethra, but that a few drops more dribble away, soiling his shirt, or even soaking through and discoloring his clothes, if their color is such that the urine can act upon the dye. An hour or two after this he again finds he desires to urinate, and in this effort is again only partially successful. In this manner he may work along for some time, experiencing more or less discomfort, but no actual suffering until on some occasion when he has been on a party, or become slightly intoxicated, or used too freely high-seasoned, stimulating food, or been exposed to cold and moisture, he suddenly finds that he cannot pass his water, or can only do so with great effort, and in small quantities at a time. This difficulty may, after a time, be partially relieved, but usually continues to some extent, the urine accumulating behind the stricture and producing dilatation which may even result in rupture of the urethra, when, as the urine is bound down by the perineal fascia, it will burrow forward and escape into the scrotum, resulting in abscess, sloughing, mortification, and the establishment of fistulous orifices in the perineum, Fig. 161; or the entire scrotum may become

Fig. 161.
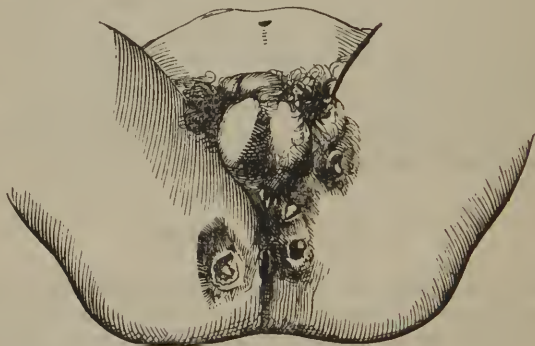


A front view of the Orifices sometimes present in Fistula in Perineo. (After Liston.)

enormously distended and slough so as to leave the testicle quite exposed. If the dilatation does not go so far as to result in rupture of the canal, it may yet create very serious consequences, as abscess of the prostate, etc., or the irritation may travel along the vas deferens to the epididymis, and epididymitis or swelled testicle result, or it may create numerous ulcerated openings behind the scrotum and before the anus. As abscesses in the perineum are often evidence of rupture of the urethra, the surgeon should always test their contents, as obtained in their evacuation, not only microscopically, but also chemically. The latter is especially useful by exhibiting the presence of even a minute portion of urine mingled with the pus, and may be thus accomplished: Evaporate a small portion to the consistence of sirup, cool it thoroughly, and then add a few drops of nitric acid, when the laminated crystals of the nitrate of urea will be formed if urine is present. If these are not found, it may reasonably be supposed that the pus is the result of a less serious disorder.

**Seat of Stricture.**—The seat of stricture varies very considerably, though it is generally found at those points at which the canal is bent or pressed

upon by any cause. Thus, it is sometimes met with at the point at which the canal first narrows, or just behind the fossa navicularis; next at the point where the penis is bent when hanging in its natural undistended condition, or when attacked by chordee; or at the bulb where the canal is compressed by the contraction of the accelerator urinæ muscle; or at the membranous portion of the urethra, where it is exposed to pressure from the perineal muscles, from enlarged prostate, etc. Stricture is, moreover, found at times in the true prostatic portion of the urethra, but this is due rather to a change in the gland than to any derangement connected immediately with the lining of the canal itself.

**Diagnosis.**—In regard to the diagnosis of stricture of the urethra, great caution will be required. The patient may have the pain, the frequent desire to make water, the dribbling of urine, etc., and yet his canal be in a perfectly normal condition. Thus, many of the symptoms described may result from the presence of stone in the bladder, or the peculiar corkscrew-like stream of urine may be simulated by the compression of the urethra, caused by the muscles when the penis is in a state of semi-erection, etc., so that the surgeon might readily be deceived were he to judge simply from the rational symptoms of the complaint as detailed by the patient; while, if not careful in the introduction of the catheter or bougie, he may also be deceived even with the use of a bougie. Under ordinary circumstances, however, nothing is more certain as a means of diagnosis in a case supposed to be one of stricture, than the introduction of an instrument, it being passed down the urethra like a catheter.*

**Prognosis.**—The prognosis of permanent stricture will, of course, depend upon the history of the case, the duration of the disease, and the character and habits of the patient. It will be favorable if the stricture has existed but a short time, if the patient is of temperate habits, and is faithful in following out the directions of his surgeon. If he is intemperate, or has had the stricture for some months, and particularly if it has acquired the cartilaginous consistency, the prognosis should be guarded.

**Treatment.**—The treatment will, of course, vary according to the character of the stricture:—

1. If it is of the spasmodic kind, and produced by the causes already given, seat the patient by the fire, and warm him thoroughly, or seat him, if convenient, in a tub of hot water, give him a moderate amount of some warm tea and some anodyne, or direct an anodyne injection to be thrown into the rectum, and then, if he is yet unable to void his urine, pass the catheter. After having evacuated the bladder, the patient will be relieved for the time, when diluent drinks, low diet, and other means calculated to make the urine as unirritating as possible, should be resorted to with a view of preventing a recurrence of the inconvenience. Should the patient be subject to this form of the disorder, benefit will be derived from lightly cauterizing the canal at the tender spot with the nitrate of silver.

2. Inflammatory stricture is to be relieved by combating the inflammation that produces it. When it is so perfect as to cause a retention of the urine, it will be necessary to employ the same local treatment as that just detailed in the spasmodic variety, except that greater care in anointing and warming the instrument, and greater gentleness in its introduction will be required.

3. The treatment of permanent stricture is very varied, and will be given under the Operations on the Genito-Urinary Organs, vol. ii.

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* For the operation, see vol. ii.

### § 5.—Cystitis and Irritable Bladder.

Another of the results of gonorrhœa is irritable bladder, or sometimes the development of true inflammation of the vesical mucous membrane.

**Symptoms.**—At a period varying from three to six weeks from the commencement of the attack, a patient with gonorrhœa will sometimes notice a cessation of the discharge, and at the same time become conscious of some irritation about the neck of the bladder, as indicated by a constant desire to urinate.    There is also present that peculiar sensation in the head of the penis which is complained of in cases of stone ; this being due to precisely the same cause, to wit, irritation of the nerves at the neck of the bladder, producing an impression which is referred to the peripheral extremity of the nerve, rather than to its origin.    The disease progressing, the patient experiences also uneasiness in the rectum, as is indicated by more or less tenesmus, which is very much like that seen in an ordinary case of dysentery. If the urine be examined under these circumstances it will be found to be variously affected.    If the irritation is limited to the mucous coat of the bladder, there will be increased discharge from the mucous follicles, and the deposits in the urine will consist principally of a certain amount of muco-purulent or purulent matter, which will settle at the bottom of the chamber-pot, and which in marked cases, when the urine is decanted off, will be left behind in the shape of a tenacious jelly-like matter.    Besides which, even in cases in which there is no apparent disorder of the kidneys, we are very likely to find in the urine, when it has stood for some time, white phosphatic deposits, the amount of which will depend upon the extent to which the irritation has gone, as well as on the constitution of the patient.    These phosphatic deposits are not merely concomitants of vesical irritation, but are also found in cases of irritation of the digestive apparatus, as after a too free indulgence in stimulating articles of diet, in wine, etc.    They are also found after too great mental exertion.

**Diagnosis.**—The character of these deposits may be tested in various ways, as by the specific gravity of the urine or the application of heat, or its reaction with nitric acid, etc., as usually advised in the treatises on the practice of medicine, the urine, etc.

**Treatment.**—The treatment of irritable bladder, or of cystitis, should it run so high as to deserve that name, will, of course, vary according to the grade of the affection.    Thus, should the inflammation be acute, active antiphlogistic measures will be required, as the symptoms may be such as will demand free local bleeding, as obtained by leeches applied to the supra pubic region, or to the cord or perineum, or to all these points at once.    After these preliminary measures, depletion, by evacuating remedies, may be carried still further by means of saline laxatives and antimonials. But purgatives of a brisk character, particularly such as have a tendency to act specially on the rectum, as aloes, etc., are contra-indicated.

Should, however, the disease have assumed a more chronic character, and present a lower grade of inflammatory action, such measures will be required as are likely to modify the neuralgic condition of the bladder.    And this will be best accomplished by means of local applications ; thus, cold water may be injected by means of a syringe and a catheter introduced into the bladder itself ; or an alterative solution may be used containing one, two, three, or four grains of the nitrate of silver to f℥j of water, beginning with the weakest solution, and increasing its strength if the exigencies of the case seem to demand it and the injection causes no pain, withdrawing the injection before removing the catheter.    If there is much pain in the

region of the bladder, or if the patient suffer much after his alterative injection, we may substitute the liq. morph. sulph. diluted with about one-half of water, and allow it to remain till voided naturally.

Should either the disease itself or the injections employed produce vesical tenesmus, as is not unfrequently the case, it should be treated precisely like the tenesmus arising in a case of dysentery, by injecting into the rectum sixty drops, or, if that does not suffice, a teaspoonful of laudanum mixed with about a tablespoonful of a thin solution of starch, the patient retaining the enema by means of pressure with warm cloths against the anus; or suppositories of cocoa-butter and two grains of opium or extract of hyoscyamus may be introduced into the bowel. Moderate purgatives will, however, be required from time to time, after the use of these anodynes, in order to keep the rectum empty, lest the weight and pressure of hardened feces should aid in keeping up the irritation. Saline cathartics, such as Rochelle salts or the citrate of magnesia, are particularly applicable, but drastic or aloetic purges should be avoided for the reasons already stated.

The urine should also be tested from time to time, and measures taken to make it as unirritating in its properties as possible; thus, if it is observed to be very acid in its reaction, advantage may be expected from a moderate course of alkalies.

Diuretics, as a general rule, should, however, be avoided throughout the complaint, and under this head may be included the free use of drinks of any kind, as anything that increases the quantity of the urine only adds to the distention of the bladder, and the vesical irritation.

With regard to the manipulation necessary in injecting the bladder, little need be said except to state that the use of the catheter is always advisable and generally absolutely necessary, it being most frequently impossible to inject a bladder except by this means. When the catheter has been passed into the bladder, a syringe should be adjusted to it and the injection carefully and slowly thrown in. The syringe for this purpose should be provided with two rings upon its cap, as well as one upon the piston rod, in order that it may be used with one hand while the other is employed in keeping the catheter in position. Sometimes the catheter employed for this purpose is a double one, so that the injection thrown in by one mouth flows out by the other, which should be provided with a stopcock, that the injection may be retained for a short time if it be deemed necessary; but should it be inconvenient or impossible to obtain this instrument, a single catheter, with or without a stopcock, may be employed, and answer a very good purpose. With regard to the form of the catheter itself, it may here be stated that the usual manner of making a number of perforations in the vesical extremity of a catheter in order to favor the escape of the urine is always objectionable, and particularly in these cases. In the first place, the numerous little orifices are liable to be blocked up with mucus, and thus prevent the flow of urine; and in the second, if the instrument is to be retained in the bladder for any length of time, particularly if the urine is acid, these various points are liable to oxidize, and thus becoming weakened, the point of the instrument may subsequently be broken off in the bladder. A much safer and more convenient form is that in which there is a large, round, or oval eye on each side of the instrument, as this eye can be polished to any degree of smoothness, while the instrument is firmer, and the orifice not so likely to be blocked up.

When chronic cystitis shows itself in the muco-purulent or purulent discharge, which has been described as vesical catarrh, advantage may be derived from the employment of stimulating diuretics — such as balsam copaibæ, cubebs, fluid extract of buchu, and soda, etc. etc. An injection of

the dilute nitric acid has also been recommended, and sometimes proved peculiarly successful. It may be used of a strength varying from one to two, three or four drops to the ounce of water, according to the irritability of the patient, but should not be strong enough to produce marked vesical tenesmus.

## § 6.—Warts.

Another complaint, sometimes seen after gonorrhœa, is one in which certain growths are observed upon the prepuce or glans penis, which are designated as **Warts**, and sometimes as **Venereal Warts**. These are a form of epithelioma due to a hypertrophy of the epithelial cells, and generally the result of some external irritation, such as that produced by a balanitis, want of cleanliness, etc. They form around the corona glandis, or on the reflected prepuce, or on the head of the penis, and are caused sometimes by obstruction in the ducts of the follicles, the distention and hypertrophy resulting from this. They are generally very amenable to treatment, and, if small, may be destroyed by touching them from time to time with a solution of chromic acid, as advised by Sigmund, of Vienna, or with the solid nitrate of silver or sulphate of copper, or by shrinking them with powdered tannic acid or acetate of lead. If large, they may be snipped off with a pair of scissors, and the raw surface thus left, lightly cauterized with lunar caustic. These warts exist, however, without the slightest venereal taint, and are sometimes the result of balanitis and want of cleanliness. There is some doubt as to their being contagious; if they are, it can only be by creating irritation in similar membranes, as is seen in warts on the hands.

Fig. 162.



## § 7.—Constitutional Results of Gonorrhœa.

Rheumatism has been spoken of by some as being among the sequelæ of gonorrhœa; but this is an error, as there is nothing even in virulent urethritis in any way liable to affect the fibrous tissues. Rheumatism may coexist with gonorrhœa, or it may follow after it in those predisposed to such attacks, from the debility induced by the disorder, but there is no reason to believe that it is in any way connected with gonorrhœa, the latter disease being a local and not a constitutional affection.

In the same manner, it has been said that a papular eruption occasionally follows gonorrhœa, and such is undoubtedly sometimes seen, a well-marked papular eruption ensuing in some cases, not however as the result of a constitutional contamination from the gonorrhœa, but as the consequence of the measures taken to relieve the discharge, it being entirely due to the too free use of the balsam of copaiba, which, by disordering the digestion, reacts on the skin. It is, therefore, a simple matter, and may readily be checked by stopping the use of the balsam and purging the patient thoroughly.

## SECTION II.

### GONORRHŒA IN THE FEMALE.

**Symptoms.**—Gonorrhœa in the female is a discharge which is caused by active inflammation of the vaginal mucuous membrane, and is not at first accompanied by that ardor urinæ which distinguishes the commencement of the disease in the male; the first symptoms noticed being usually an irritation about the vulva, followed by an increase of the natural mucous secretions of the part. As the disease progresses, this discharge becomes purulent in its character, then ichorous, and very irritating, so that as it runs down over the posterior commissure and fourchette it produces more or less excoriation, and gives rise to violent burning, with inflammatory swelling of the vulva. As the surface involved is very extensive, the discharge is generally quite profuse, requiring often the use of a napkin to preserve a tolerable amount of cleanliness, and to prevent the excoriation which is so apt to result from the acrid character of the pus. As the disease continues, the urethra becomes involved, and then there is more or less ardor urinæ, as was the case in the male. On examining the parts carefully with a speculum, acute inflammation will now be seen in the labia minora and vagina, and sometimes excoriation and abrasion of the mucous membrane covering the os uteri, the whole vaginal canal being swollen and tender, so much so that the introduction of the speculum is sometimes intolerable from the pain.

**Diagnosis.**—The diagnosis of gonorrhœa in the female is often a question of great moment, so far as the feelings of the patient are concerned, yet a matter of very great difficulty in some instances. Leucorrhœa, which is a very common complaint, may, where there is want of cleanliness, simulate gonorrhœa so closely as to render it difficult if not impossible to distinguish them, the leucorrhœal discharge being first mucous, then thick and purulent, and finally becoming yellowish or greenish, but it seldom if ever causes ardor urinæ; while Ricord has stated that in gonorrhœa eight out of twelve females examined had a discharge from the urethra, this being unusual in leucorrhœa; the glands of the groin are also seldom enlarged in leucorrhœa, though apt to be so in gonorrhœa. The diagnosis is, however, always difficult, but it may be said, as a general rule, that the marked vulvar irritation produced by leucorrhœa is much less diffused than that created by gonorrhœa, and if the patient has ardor urinæ, a profuse greenish or yellowish-green discharge, more or less swelling of the labia, particularly the labia majora, with sympathetic enlargement of the glands of the groin, it will be quite right to look upon the disease as gonorrhœa, especially if the patient is likely to have been exposed to the cause which alone can produce it. The uncertainty of the diagnosis, however, should make the surgeon very careful in expressing an opinion, in any case where medico-legal questions are involved, or where the expression of his sentiments would produce domestic unhappiness and distress, and it is often best not to criticise the symptoms too rigidly, as the mental suffering in these cases is often much more severe than the bodily, a lady not unfrequently bearing uncomplainingly the bodily discomforts of the disease while believing that she has no virulent disorder, who would suffer exceedingly at the idea of contamination on the part of her husband.

**Prognosis.**—The cure of gonorrhœa in the female is generally much more readily accomplished than in the male. There is, it is true, a much larger extent of surface, and one the action of which it is more difficult to change than is the case in the urethra of the male; but as the urine does not pass

over the diseased surface, there is not a continuous repetition of irritation, nor the difficulty of making accurate applications to the diseased surface, as in the case of the male. The chief reliance in the treatment is to be placed in vaginal dressings, and these, if promptly employed, rarely fail to cure in about fifteen days.

**Treatment.**—When called to a case supposed to be gonorrhœa in a female, the first thing to be done is to examine the parts, if possible, by means of a speculum, as we can thus ascertain the extent of the trouble and learn how far the mucous lining of the vagina is involved in the disorder. The speculum used in these cases may be a simple bivalve, trivalve, or quadrivalve, though a much better instrument is the fenestrated speculum recently made in Paris, but now for sale by most of our cutlers, by means of which the whole vaginal mucous membrane can be very thoroughly exposed, as the instrument can be readily introduced without causing pain. Being satisfied of the condition of the vagina, some astringent injection may be ordered proportioned in strength to the grade of the disease. As a general rule, however, much stronger injections are advisable in the female than could be employed for a similar condition in the male. In the use of an injection, special directions should be given that the parts be first thoroughly cleansed by means of an injection of soap and water, when a strong infusion of white-oak bark, or a solution of alum, of sulphate of zinc, about four grains to the ounce, or some similar substance may be thrown into the vagina while the female is reclining in a horizontal posture, with the hips raised by a pillow placed beneath the pelvis. The injection may be thoroughly introduced and held in the vagina by means of Davidson's gum-elastic syringe; or she may use the self-injecting apparatus, or clyso-pompe of the cutlers, or some similar means. The ordinary glass female syringe, with little holes in the side, is of no use, being too small, and not bringing the injecting material in contact with the whole of the canal.

A very excellent and in most cases preferable plan of treatment is that suggested by Ricord. This consists in moderately distending the vagina by means of charpie which has been soaked in some astringent or alterative solution, such as the sulphate of zinc, acetate of lead, nitrate of silver, etc. The vagina may be partially packed with the lint thus prepared by means of the fenestrated speculum, and the solution be kept in contact with every portion of the walls of the canal for some time, so that its full effect can be obtained, the charpie being retained, if necessary, by means of a T-bandage or napkin applied against the perineum. After forty-eight hours this packing may be removed, and a second or even a third or fourth application may be necessary; but usually the disease is said to be cured by this plan in a very short time. Gaudroit has advised the use of the following vaginal suppository, which will often prove valuable:—

R.—Solut. zinc chlorid. gtt. v ;
      Morphiæ sulph. gr. ss.

Mix with the following paste, and make into a twenty-grain suppository:—

Mucil. tragacanth. 6 parts ;
Pul. saccharum, 3 parts ;
Pul. fecula, 9 parts.

**Spurious Gonorrhœa.**—The surgeon will sometimes be called upon to express an opinion in cases of what is supposed to be gonorrhœa in young females under ten years of age, on whom it will be asserted, or feared, perhaps, by the mother of the patient, that a rape has been attempted by some

one laboring under gonorrhœa. Now it is important, under these circumstances, that the young surgeon should be acquainted with the fact that female children are not unfrequently attacked by a mere leucorrhœal discharge, which, in the irritable or uncleanly, may simulate ordinary gonorrhœa—worms, irritation in the rectum, scrofulous disease, want of cleanliness, and many other causes, giving rise to such a complaint; and that there are many instances on record, in which men have been tried, and convicted—most unjustly—of attempts to commit rape where there is no doubt that the discharge arose from perfectly natural causes. It should also be remembered, in the investigation of such a case of supposed rape, that anything like an attempt at coition, fairly made upon a child of less than ten years of age, would produce such an amount of bruising and laceration of the vulva as would be readily recognizable, and that in the great majority of cases of this sort there is not the slightest ground for the charge. Percival, in his "Medical Ethics," Kinderwood, of Manchester, Wilde, of Dublin, Taylor and Beck, in Jurisprudence, etc. have all cited cases proving the groundless character of these charges in many instances. A careful examination and cross-questioning will most generally show that the child has been induced to charge the rape upon some one, by threats of the mother, who in ignorance and distress endeavored thus to obtain the truth. The surgeon should therefore be especially careful not to sanction, by the expression of his opinion, any such charge, unless satisfied that there is no other cause for the disease, and that the symptoms are not due to "infantile leucorrhœa." "Noma pudendi," or superficial gangrene of the pudendum, sometimes of a most serious character, is also liable to mislead the inexperienced. In the Medico-Chirurg. Transactions, vol. vii. p. 84, interesting cases of noma will be found which will suffice to show the liability to error in connection with the diagnosis of the disorders of the sexual organs of female children.

# CHAPTER III.

### SYPHILIS.

UNDER the general term of **Syphilis** is correctly designated a specific disease, caused by a virus which acts like animal poisons—creating at first local irritation at the seat of the inoculation, and developing a poison which, after entering the circulation, is eliminated from the blood in the same manner that small-pox is after inoculation, or when otherwise produced. How scarlatina, measles, and other eruptive diseases are induced, is not positively known; but that they run a regular course, and are cured by nature, is well established. Nor can we explain how syphilis, when once introduced, modifies the actions of the economy, even to the third generation; but that it does so, is unfortunately too well established to admit of a doubt. That syphilis, like measles and scarlatina, is also capable of being cured by the efforts of nature, is believed by many, though its relief by drugs has long been regarded by a large portion of the profession as a settled point. That syphilis, in a bad constitution, will, if left to itself, cause suffering, destruction of tissue, and death, is indubitable; but that it cannot be eradicated from a good constitution, if not treated, has never been tested. It is, however, important to recollect that the symptoms of syphilitic virus in the blood are the evidences of the

efforts of nature to eliminate the poison from the system.    Hence the erup-
tions of the skin and mucous membranes should be judiciously encouraged,
and not hastily interfered with by destructive remedies, or such as weaken
the digestive and reparative functions of the economy.

Syphilis may be developed either by an impure coition or by inoculation.
In either case the virus must be so placed beneath the cuticle or epithelium
that it may be absorbed.    When thus located, its first effect is that of an
irritant, which soon creates a local and unhealthy inflammation, accompanied
by a sensation of pricking, followed by redness; then by an elevation of the
cuticle or epithelium, from effusion of serum, which thus forms a vesicle;
then by the formation of lymph, then of pus; and, this little pustule or abscess
being discharged, we have a more or less deep and circumscribed ulcer,
covered by a specific pus, the ulcer being designated as a **Chancre** or
**Primary Sore.**    The production of this sore and its local effects, as the irri-
tation, enlargement, suppuration and ulceration of the adjacent lymphatic
glands, (bubo,) constitutes the stage of the disorder which is classified for
study as **Primary Syphilis.**

It has long been usual, in describing a chancre, to speak of its pus as
being absorbed, and thus infecting the blood; but such an expression must be
received in a qualified sense, it being well known that pus cannot be absorbed,
although the fibrinous exudation which furnishes the pus may undoubtedly be
thus taken up, and create blood poisoning.    In the chancre, as in other ulcers,
we have a free surface discharging pus, and below this a series of exudation
corpuscles with fibrinous matter, developed doubtless in the spot by the
change of cell action which ensues on the application of the irritating inocu-
lating cause.    From this we may, therefore, learn the value of the practical
precept of wiping off the pus of every chancre before cauterizing it, in order
that the caustic may act directly on the layer of exudation corpuscles which
is connected with the fibrin furnishing the pus, and doubtless more or less
mixed up and identified with it.

The blood being once poisoned by absorption of the pus serum or fibrin from
the primary sore, the effort of nature to eliminate it is shown by general
irritation and fever, this being, in marked cases, followed by congestion or
spots on the skin and mucous membranes of a peculiar, coppery hue, followed
by vesication and ulceration, as well as by a cicatrix, which is depressed,
and usually shows a loss of substance.    In milder cases the fever may be
absent, and the affections of the skin and its appendages, as the hair and
nails, with disorder of the mucous membranes, especially of the nose, mouth,
throat, and larynx appear first, in either case developing the stage known
as **Secondary Syphilis,** a modification of normal nutrition, believed to be
capable of transmission to the unborn infant, in whom a similar train of
symptoms may appear, as will be again alluded to.

When the disordered action interferes with the nutrition and function of
the osseous and fibrous tissues, it develops **Tertiary Syphilis.**

Starting, then, with this brief and general statement, we may—first, study
the symptoms of the primary sore, which is the commencement or origin of
the disease, or the surface from which the poison is scattered throughout the
system, a surface which, if changed in its action so as to modify its fibrinous
layer, prevents the further development of the disorder; next, we may inves-
tigate the secondary and tertiary periods, or the effects of the poison on the
general nutrition of the various tissues of the body.

# SECTION I.

### PRIMARY SYPHILIS.

A **Chancre** or **primary sore**, being the result of the application of a specific local irritant, will present varied appearances, in accordance with the virulence or irritating quality of the matter thus applied, and the time that has elapsed from the application until its effects are noted.

**Seat of Chancre.**—As it is necessary for inoculation that the virus should pass beneath the cuticle or epithelium, the most common seats of chancre are the points where these tissues are thinnest, and most likely to be cracked or torn by mechanical action, such as the frænum of the prepuce, which is often so violently distended during coition as to create a rupture of the epi-

Fig. 163.                                                Fig. 164.

The common seat of Chancre—the sore presenting the characters of that with an indurated base, and which is designated as the Hunterian Chancre. (After Acton.)

Chancre of the acute Phagedenic variety, seated around the Corona Glandis. (After Acton.)

thelium covering the part. The frænum is, perhaps, the most frequent seat of chancre, while next we have the corona glandis, or the part just behind it, where the mucous membrane is reflected from the penis upon the prepuce, this being also very apt to be stretched during copulation, in consequence of which it becomes abraded or cracked. The next most frequent seats of chancre are the skin of the body of the penis, or of the scrotum, or the lips and tongue. It is also to be found in the eyelids, from rubbing the eyes with the hands, on which there may be chancrous matter. In the female it is found upon the labia minora, near the meatus urinarius, upon the fourchette, within the vagina, upon the os uteri, on and around the nipple, in the axilla, etc., while it may be inoculated anywhere.

**Symptoms.**—The symptoms of primary syphilis are as follows: In from two to four days after an impure connection, there is seen on the prepuce, or corona, or on the body of the penis, or upon the labia minora or majora, or within the vagina, a red inflamed spot; which is combined with a certain amount of smarting or stinging, sufficient in the penis to give rise to an afflux of blood to the part, and cause a marked irritation and disposition to erection, this erection, by stretching the parts, aiding in the extension of the sore, the little red inflamed spot, at this early period, exhibiting only the ordinary characters of unhealthy inflammatory action. The cuticle covering it, however, soon becomes elevated by the effusion of serum beneath it so as to make a little vesicle, the serum of which shortly assumes a yellow color from an admixture of pus, and finally becomes quite purulent. The distended pustule sometimes becomes depressed in the centre, or umbilicated, thickens and forms a scab, or bursts, and, discharging itself, leaves a slight

superficial abrasion or ulcer.    In this condition this ulcer is a simple ulcer-
ated surface, secreting, it is true, a specific pus, but yet susceptible, after a
light cauterization, of being healed by the ordinary treatment of inflamma-
tion elsewhere.    It constitutes the **Soft Chancre** of Ricord.    In other cases,
after the pustule has progressed for a few hours it bursts, and presents an
ulcer, which is changed in its appearance, owing to the efforts of nature to
prevent its extension, this being accomplished by means of an effusion of
fibrin, in consequence of which the sore acquires defined edges, and more or
less induration around its borders.

In the course of twenty-four or thirty-six hours after the first appearance
of this ulcer it will be found that the sore has changed its characters, and,
instead of presenting a superficial abraded surface, covered by pus, as was
seen in the soft chancre, has now taken on the character of a very superficial
slough, and is covered by a soft, pulpy structure of various depths, this death
of the tissue being in proportion to the virulence of the disorder.    The efforts
of nature to limit the extension of the disease now become more marked,
the edges of the chancre become thicker and more rounded, and it acquires
a greater apparent depth, owing to the effusion of fibrin on its edges, while
it obtains a hardened base, which can be distinctly felt by pinching the parts
between the fingers, this base presenting the condition to which the term
**Hunterian chancre** has been applied, from the fact that this sore was first
accurately described by John Hunter.    It should, however, be remembered
that though such a chancre commences like the simple sore or soft chancre
first described, it becomes deeper and more rounded on its edge, in a manner
analogous to that by which the edge of an ordinary indolent ulcer is made
to differ from that of a simple healthy ulcer of the leg, though this chancre is
also developed in a few hours with an indurated base, especially if the virus
is potent, or the constitution or reparative efforts of the system have been im-
paired by excesses.    As long as a chancre has not induced a bubo it should
also be recollected that it is perfectly amenable to a local treatment, and
that it may be healed without the poisonous or specific pus contamina-
ting the patient's system.    But if a primary sore is allowed to progress un-
checked, inflammation in the lymphatic glands of the region will next be
noticed, a red line being observed to extend along the back of the penis in
a direction corresponding with the course of the lymphatics.    The lym-
phatic glands of the groin will next become involved, and begin to enlarge,
constituting what is ordinarily designated as a **bubo,** or the lymphatics
of the penis itself may enlarge and thus create a true abscess of the penis.
When a bubo forms in the groin it will often run on to suppuration, when
the discharge thus formed proves to be precisely like that originally obtained
from the chancre, and if introduced beneath the skin of some other part, as
upon the thigh of the patient, will produce another chancre precisely similar
in all respects to the first one.

The discharge from a chancre will usually stain the linen as did that of
stricture, but, perhaps, in a more marked manner, producing a heavier tal-
low-like stain.    It has, moreover, certain properties which may be described
under the head of the "Laws of Chancre," as established chiefly by the talents
and industry of M. Ricord.

1. The discharge from a chancre, or from its consequent bubo, whether
upon the penis or the groin, will always reproduce a chancre wherever it
may be inoculated.

2. It will produce an irritation that will travel along the lymphatics and
develop inflammation and suppuration in the first lymphatic gland.

3. It will create irritation and suppuration in each gland that is involved,
and the bubo thus formed will produce a discharge of the same character-

istics as that found in the original sore; that is, the matter from such a bubo, if introduced on the point of a lancet, beneath the sound skin of any portion of the body, will in three or five days induce a condition similar to that seen in the formation of the original chancre.

This condition, it must be constantly recollected, is a modified nutritive action of the cells of the tissue affected, in consequence of which they produce a matter analogous to healthy fibrin, yet predisposed to degeneration. Hence it is best overcome by such means as tend to develop a healthy cell action, as will be seen in the treatment of chancres.

**Diagnosis.**—From the description of the primary sores (soft and indurated chancre) just given it will readily be seen that there are many conditions which a careless observer might confound with the earliest stage or the commencement of chancre. Thus, a man may have connection with a filthy woman, or he may himself be of filthy habits, that predispose to inflammation of the part, in consequence of which the mucous membrane covering his glans penis will become abraded; or the irritation produced by mere contact with the acrid matters of the female vagina may produce a little vesicle, or a number of little vesicles, and these will be found upon the frænum and behind the corona, which, it should be remembered, are the most frequent teats of the primary sore; but these sores are nothing more than the *vesicles of eczema*. Then, again, it should be remembered that there is a true herpes of the glans penis, or of the prepuce, the vesicles of which are not unlike those seen in the commencement of chancre, which, when they burst, also form a little superficial excoriation which may readily be confounded with chancre by an inexperienced observer. But the surgeon may always make a correct diagnosis by noticing that the sore left by herpes never runs on to a deep ulceration like true chancre; that it does not form a thick, gummy or profuse pus; is not covered by a pultaceous slough, and does not produce a suppurating bubo, although at times it results in a sympathetic one, which generally disappears in a few days; or if these facts are not sufficient, the diagnosis can always be definitely settled by Ricord's experiment of inoculation; thus if the pus from a supposed chancre does not reproduce a chancre, it may be safely asserted that it is not a specific sore. Although, then, the diagnosis in the early stages of the primary sore, and especially the soft chancre, is difficult, that between other sores and the Hunterian chancre may be readily made.

**Prognosis.**—The prognosis depends on the period of the disorder; if seen early, before the local changes are marked, it is possible to check the diseased action, and the prognosis will be favorable; otherwise there is risk of blood poisoning and the development of secondary syphilis.

**Treatment of Primary Syphilis.**—The treatment of the primary ulcer, after it is reduced to the condition of a simple sore, is to be conducted upon the general principles of inflammation, the great danger being from the absorption of the specific matter found on its surface. The indications for the treatment, therefore, are:—

1. To check or modify the secretion from the chancre.
2. To prevent the absorption of its virus into the system.
3. To heal the ulcer that is left.

The first indication, or the modification of the secretion of the chancre, is to be accomplished by such means as will change the whole character of the sore, such, for example, as the application of lunar caustic; a gentle cauterization with the nitrate of silver being generally sufficient to answer that purpose, this being repeated until the sore presents a disposition to cicatrize; the chemical action of the caustic and the healthy inflammation it develops being generally sufficient to alter completely the local cell action and the

specific nature of the pus. But it should be remembered that the nitrate of silver is to be applied with a view to its alterative effects, and not in order to create a deep eschar and "burn out the sore," as this is not necessary in the first stage of the soft chancre, and creates an amount of irritation which the circumstances do not require. If we have the Hunterian chancre to treat, a more powerful caustic may be demanded, as will be explained when considering the treatment of this form of chancre.

If the nitrate of silver is not at hand, an alterative effect may sometimes be produced upon the surface of the sore by means of a solution of one of the milder chlorides, such, for example, as black wash, which may be made in the proportion of $\mathfrak{z}j$ of calomel to f$\mathfrak{z}iv$ of lime-water, lint saturated with the above solution being constantly kept upon the sore. But whatever stimulant is employed, let it be remembered that the surface to which it is applied should be first wiped dry in order that its action on the primary layer of exudation corpuscles may be more direct.

Sometimes instead of an external chancre we may notice one which is directly within the fossa navicularis, in consequence of which it is designated as a concealed chancre, though it can generally be seen at the edge of the urethra, by opening the lips of this canal. This chancre, it is said, may be found farther in; but if this is true, it must be extremely rare, as it is a difficult matter for the inoculating pus to travel much farther into the urethra than the fossa navicularis, and find an abrasion. The treatment of the concealed chancre is the same as that of the chancre which is external to the urethra, its cauterization being accomplished by the introduction of the solid stick of caustic within the urethra, or by throwing in a strong solution of the same, taking care to limit its action by constricting the urethra behind the corona glandis.

As regards the second indication—the preventing of the absorption of the virus—it is best carried out by such means as will remove the pus from the sore as rapidly as it is formed, and these are to be found in a frequent change of dressings, the lint which is placed in contact with the chancre being changed every two or three hours; while anything like the formation of crusts or scabs is to be studiously prevented, lest the virulent pus accumulate beneath them and thus be absorbed.

As the inflammation produced by chancre is always of an unhealthy character, it will be found advantageous to moisten the lint, with which the simple ulcer is subsequently dressed, with some stimulating article, and a very excellent one is the aromatic wine of the French Codex. (See p. 261.)

Lint, wet with this solution, may be applied to the ulcer, and changed at least every three hours until the application becomes too stimulating, as will be shown by its smarting, when the wine may be diluted with a little water. If the discharge from the ulcer is very profuse, a small quantity of tannic acid may be added to the aromatic wine with a view of diminishing the secretion, about ten grains of tannic acid being added to each ounce of the wine. But it is possible to apply the astringent to such an extent as to prevent the organization of fibrin and the development of granulations, thus interfering with the perfect cicatrization of the sore, a result that should be guarded against by diminishing the quantity of the tannic acid, and temporarily employing warm mucilage.

The third indication—the healing of the sore—is to be accomplished in precisely the same manner as the healing of any other ulcer, that is, by means of heat and moisture applied through warm mucilages, ointments and greasy applications not answering so well as simple washes, especially those which are mucilaginous. If the sore does not heal with sufficient rapidity, it may be lightly touched from time to time with the solid stick of the nitrate

of silver, or with a solution of thirty grains of this salt to the ounce of water.

Thus far primary syphilis requires little or no constitutional treatment, a slight purge, attention to the condition of the digestive organs, and such general remedies as would be appropriate to any inflammation, being quite sufficient, the primary ulcer, after it has been cauterized, being treated precisely as if it had been produced by any other cause. The simple primary sore thus early seen and properly treated is therefore a very simple affair, and much less troublesome than gonorrhœa. But if the patient allows the ulcerative action to progress, as he is very apt to do, on account of mistaken notions of the purity of the woman from whom, in truth, he has received it, or if from the first he presents the evidences of the true Hunterian chancre, more active measures will be demanded.

The treatment of the indurated or Hunterian chancre is more troublesome than that of the simple chancre recently alluded to, because it does not yield to the mild applications just named, owing to the induration of its base by the effused fibrin. Sometimes, on account of the depraved condition of the patient's blood, or other causes, marked signs of unhealthy inflammation develop themselves, and there is no longer a disposition to the organization of lymph; hence, as the inflammation is not limited, the chancre is disposed to spread with greater or less rapidity. When the sore exhibits this condition it is called a **phagedenic chancre,** or if it sloughs with great rapidity, a **sloughing phagedena.** A sloughing chancre will sometimes progress to such an extent as completely to surround the head of the penis with deep ulcerations, thus creating a loss of structure which is never afterward replaced.

Owing to the induration of its base, and the amount of fibrin deposited around the suppurating surface, the Hunterian chancre requires a more powerful caustic than that applied in the case of the simple chancre, as it is necessary not only that the sore itself, but its indurated base and edges should also be sloughed out. In these cases the use of caustic potash, or the strong acid nitrate of mercury, is preferable to the nitrate of silver, as after the slough resulting from these applications has come away, there is left a clean healthy ulcer without induration, the treatment of which is the same as that detailed for the simple chancre.

The treatment of the phagedenic chancre, like that of other phagedenæ, must be prompt and active, as it is worse than useless to attempt to palliate or reduce the unhealthy inflammation which is here present, by the use of the ordinary antiphlogistic measures. Such measures, particularly if actively carried out, always result in a more rapid spread of the ulceration, and there is, therefore, but one course to pursue, and that is, to destroy the whole unhealthy surface, by cauterizing it with strong acid nitrate of mercury, as this is more certain, and penetrates more deeply into the tissues than nitrate of silver or caustic potash. The application of caustic potash may accomplish the same thing, but it is not so well adapted to the purpose as the strong nitric acid. In employing the acid, care must be taken to limit its action by the prompt application of sweet oil, or of the bicarbonate of soda, in solution. After thus checking the sloughing process by a local treatment, too much attention cannot be given to improving the general nutrition of the patient, a gentle stimulating diet being employed as before directed, in connection with mortification.

Occasionally it will happen that the inflammatory action developed by the presence of a chancre leads to an effusion of serum or of lymph into the prepuce to such an extent as to produce phymosis. In such a case we should not incise the prepuce until the chancre is healed, this being accom-

plished by means of appropriate injections beneath the prepuce, when the swelling will often be so much diminished that the phymosis can be over-come by mere manipulation; or if not, the operation can then be safely performed without the risk of inoculating the edges of the incision with the chancrous pus.

The cicatrix left by a chancre, and especially the Hunterian variety, is a peculiar one, and never thoroughly disappears, while as it is depressed it shows clearly that there has been a loss of substance. Sometimes this cica-trix is observed to have a thickened edge, or when felt shortly after the ulcer has healed gives the sensation of a little cartilaginous induration beneath the tissues affected. Whenever such a cicatrix exists, as its lymph contains the virus of the disorder, the patient is liable to suffer from constitutional symptoms and to transmit the disorder to his offspring. The best plan that can be followed to prevent it, is therefore again to apply caustic to the cica-trix, and compel the entire induration to slough out, administering at the same time such diuretics, purgatives, and alteratives, especially iodide of potassium, as will favor the elimination of noxious matter from the blood.

But it often happens that patients are not placed under treatment until the chancre has existed some time, and that there is therefore reason to fear the contamination of the blood from absorption of the virus. That absorp-tion of an irritant of such a character as creates a primary sore could take place without developing adenitis or a bubo, seems improbable, and it is by no means certain that the so reported cases have always been carefully noted, or a correct history given by the patients. When met with, they are certainly rare exceptions to a general rule. It should, however, be remem-bered that there are lymphatics on the under surface of the penis that enter the pelvis, beneath the symphysis of the pubis, and that consequently urethral chancres, or those on the glans penis, are most apt to produce secondary symp-toms, because the absorption is not suspected, owing to the absence of a bubo. Such constitutional treatment as is hereafter stated in the considera-tion of secondary syphilis, may therefore sometimes be demanded in connection with the treatment of the primary sore, that is to say, warm baths, purging, iodide of potash, and iron, which will often not only favor the healing of the primary sore, but anticipate the evidences of secondary syphilis, or diminish its violence by exciting the natural means of eliminating noxious matter from the blood. But I desire to impress upon the reader the fact that, as a general rule, the simple chancre will heal readily under a proper local treat-ment; that the Hunterian chancre, if seen early and in a good constitution, will do likewise, but that both may require general remedies if met with under different circumstances, not under the antiquated notion of eradicating one poison by introducing a more potent one into the system, but simply by augmenting the reparative powers of the part by such means as would be appropriate to the treatment of an irritable leg ulcer in a man of dissipated habits. Any constitutional treatment of primary syphilis that is not based on the general principles of inflammation is useless, if not absolutely injurious in most cases, and especially in the treatment of the simple primary sore. Local cleanliness, reduction of local irritation, with the administration of opiates, diaphoretics, diuretics and purgatives, when evidently required, are all that is necessary in addition to the change of cell action developed by a proper cauterization of the sore at an early period.

## § 1.—Bubo.

The term **Bubo**, which is generally applied to the syphilitic affection of the glands of the groin, is one also employed indiscriminately to designate all enlargements of the lymphatic glands, whether caused by syphilis or not, as the term indicates merely a swelling in the groin.

**Symptoms.**—The symptoms of a syphilitic bubo are as follows: There is fullness in the groin, with pain, tenderness upon pressure, and swelling. As these symptoms increase and the swelling progresses, the pain becomes quite severe, because the enlargement of the gland is limited by the dense superficial fascia of the part, and when suppuration is established, the pus, owing to the same cause, has a disposition to burrow and travel in various directions. At last, the products of inflammation distend the skin to such an extent that it ulcerates and gives way; the pus is evacuated, and then an ulcer is left similar to the primary sore, though on a larger scale, presenting elevated rounded edges, with a slough at the bottom, consisting of the structure of the degenerated lymphatic gland, the pus of this ulcer being also capable, by inoculation, of reproducing another chancre.

**Diagnosis.**—As it sometimes happens that a bubo occurs from mere local irritation, as in a case of simple gonorrhœa, herpes, etc., it may become a question whether the swelling is of syphilitic origin or merely a sympathetic enlargement produced by the irritation of the urethritis, and this question can generally be determined with tolerable certainty by remembering the following facts:—

The gonorrhœal and sympathetic bubo usually present an enlargement of several glands at the same time, because the irritation from urethritis is not sufficiently great to cause suppuration in one gland before another enlarges; while in the syphilitic bubo the inflammation so rapidly develops pus that one gland suppurates before the next is attacked, and thus the syphilitic bubo usually involves but one gland at a time.

Sometimes there will be enlargement of the glands of the groin from a very simple cause, as when the patient stumps his toe, or cuts his corns too closely, or has a toe-nail ulcer, these causes being often quite sufficient to cause a sympathetic enlargement of the glands in the groin; but this bubo corresponds with that described as the result of gonorrhœa, two, three, or several glands being attacked at the same time. It has also not the same tendency to run on to suppuration that is found in the syphilitic bubo. A more difficult matter is to diagnose between the syphilitic bubo and that which is occasionally found resulting from mere irritation produced by cauterizing the chancre in its earlier stages with nitrate of silver. But the delay of a single day will enable the diagnosis to be readily made, as in that time the bubo produced by the irritation of the caustic will be much better, while that produced by the syphilitic virus will be worse. When a patient has a sympathetic bubo at the same time that he is suffering from both concealed chancre and from gonorrhœa, it will, however, be difficult to decide whether the bubo is produced by the gonorrhœa or the chancre, except by a careful inspection of the orifice of the urethra, on the edge of which the chancre will generally be found, as the pus from the urethritis under these circumstances may create a chancre if employed for inoculation. When pus from the urethra is inoculated on the thigh or elsewhere, and produces a true chancre, there can be no doubt of the existence of another chancre in the canal, and a careful examination will usually at once detect it. Gonorrhœal pus will *not* produce a chancre, as has been well established by the extended experiments of Ricord; neither will the pus from a bubo, unless the latter is of syphilitic origin.

**Treatment.**—When a bubo is certainly syphilitic, and follows the development of chancre, when one gland alone enlarges and runs rapidly on to suppuration, no time should be lost in getting rid of the pus or of the entire gland, so as to prevent the absorption of its pus serum into the blood and the contamination of the patient's constitution. If the least point of suppuration can be detected, the bubo should therefore be at once freely lanced, the pus discharged, and then the entire cavity cauterized, by rubbing into it caustic potash, the action of the potash being immediately checked by injecting olive oil. But if the bubo has not suppurated and is of some size, with the skin reddened and swollen, while at the same time an indurated Hunterian chancre exists on the penis, the entire gland should be made to slough out by the following prompt though painful means, so that the patient may be secured from constitutional taint. Give the patient a full dose of anodyne; then shave the groin free from hair, and apply a blister over the bubo for six or twelve hours, or until it vesicates sufficiently to remove the cuticle, after which apply to the denuded surface a compress of patent lint of the size of the bubo, wet with a strong solution of the sulphate of copper, say two drachms of the salt to an ounce of water; lay over this another compress of dry lint and bind the whole firmly to the part by means of a spica bandage. In between twenty-four and thirty-six hours, this dressing may be removed and the warm water-dressing applied so as to favor the separation of the slough; these dressings being retained by the Spica Handkerchief of the Groin suggested by Mayor, Fig. 111, p. 158, or by the Triangular T of the Groin, Fig. 74. If preferred, instead of the sulphate of copper the acid nitrate of mercury may be used; but, in this case, it is not necessary to remove the cuticle. In applying the acid, surround the part with a little elevated line of basilicon ointment, and then spread the acid well over the part, allowing it to remain for a few minutes, when it should be neutralized with carbonate of soda. Some surgeons prefer for the same purpose the use of the chloride of zinc, or a strong solution of the bichloride of mercury, which they rub over the bubo until the whole is converted into an eschar. In either case, the slough should be deep enough to involve the entire gland, so that when the dead portion comes away the diseased gland may be removed, and a simple ulcer left which will be amenable to the ordinary treatment of ulcers.

The simple bubo from gonorrhœa requires a very different and much milder treatment, such as the application of cold water; pressure, leeches, etc., to check the inflammatory action; or if it runs on to suppuration, an early evacuation of its pus should be practiced, and then the sore stimulated slightly. If, however, the inflammatory action becomes chronic without going to such an extent as to induce suppuration, and an indolent induration of the glands is established, these should be treated by such means as will modify the organization of the lymph, precisely as a chronic induration from inflammation would be treated in any other part, or arising from any other cause, by the application of small and repeated blisters, or of stimulating ointments, while some one of the preparations of iodine may be given in alterative doses in order to change the local cell action and facilitate the removal of the fibrin. The local use of iodine will also sometimes prove highly useful, on the principles alluded to in the treatment of tuberculosis.

## § 2.—Syphilis in the Female.

When syphilis shows itself in the female, it obeys the same general laws, and is amenable to the same treatment as when manifested in the male.

**Seat.**—The most frequent seat of chancre in the female is around the meatus urinarius; upon the labia minora; upon the os uteri and upon the fourchette. It is, however, found at times upon other places, both upon the organs of generation and elsewhere.

**Symptoms.**—The symptoms of chancre are more marked, and the ulcers more apt to become phagedenic in the woman than in the man, from the fact that the healthy or diseased discharges of the uterus and vagina flow over and still further inflame the ulcerated surface. As a consequence of this, large chancres, especially of the phagedenic variety, are very apt to form upon the posterior parts of the perineum; or two chancres, one on each side, may unite at the fourchette, and constitute what is known as the *horseshoe chancre.*

**Treatment.**—Chancre in the female, if simple, is to be treated precisely like the simple chancre in the man, and if phagedenic or Hunterian, after the manner just alluded to; the treatment above given being equally applicable to both sexes.

## SECTION II.

### SECONDARY SYPHILIS.

Thus far we have considered syphilis simply as a local disease, but should the virus enter the system, should the bubo or chancre be improperly treated, should such an indurated cicatrix as has just been described be allowed to remain, or even when the sore has been well treated, and has apparently healed in the most favorable manner, but yet been attended by an enlarged gland, or when the chancre has been seated within the orifice of the urethra and remained unnoticed, evidence of blood poisoning may present themselves a few weeks subsequently. In this case certain constitutional symptoms will appear and present examples of the affections of the skin, of the mucous membranes, and of the iris, together with disorder of the digestive organs, and consequent malaise, fever, restlessness, want of sleep, and emaciation. These symptoms, or one or more of them, indicate usually the condition called **Secondary Syphilis.**

**Symptoms.**—About six weeks after the appearance of a chancre, sometimes where the chancre has been healed, the bubo sloughed out, or, in the cases before alluded to, where, from the position of the chancre, the virus has entered the circulation through the deep lymphatics, or where there has been no marked bubo, the patient will begin to notice some little feebleness in his digestive organs, accompanied by a loss of appetite, and by a disposition to emaciation—this emaciation being sometimes ultimately so marked as to make the patient look older than he really is. These symptoms show themselves as follows: the cheeks are depressed from the loss of the fat beneath the malar bone, and the skin sallow and wrinkled. At the same time the eyes will be heavy; the patient will sleep badly, be irritable and dispirited, and have a quick, febrile pulse, while night-sweats will often be exceedingly profuse, and simulate the condition that has been alluded to as the symptoms of irritative fever.

These symptoms will, moreover, be much augmented if the patient has

been salivated, because then, in addition to the constitutional irritation pro-
duced by the disease, we have that created by the mercurialization, this
giving so precisely the same pulse, febrile state, emaciation, etc., that it is
difficult in some cases to say whether the symptoms are caused by syphilis
or by mercury. At a period which varies, sometimes preceding, sometimes
following, sometimes coincident with, and sometimes without any accom-
panying disturbance of the digestive organs, there will be noticed affections
of the skin and throat, these being, evidently, the efforts of nature to get rid
of the virus, precisely as the eruption in small-pox is due to the efforts of
nature to throw off the blood poison that has produced the fever, etc. As
the appearance of the eruption in secondary syphilis varies according to the
part affected, the symptoms may be best examined in connection with each
tissue.

### ?  1.—Affections of the Mucous Membranes.

The affections of the mucous tissues, as a consequence of primary syphilis,
usually begin with a slight irritation in the pharynx, of which the patient
complains, and which he compares to the irritation of ordinary sore throat;
thus he will have some little hoarseness, and, perhaps, some slight stoppage
of the nose, precisely resembling that of an ordinary catarrh; the secretion
produced by these irritated surfaces being so thick and gluey that he expe-
riences a constant inclination to hawk in order to get rid of it. At the same
time, or soon after, he begins to experience difficulty in deglutition, and,
upon looking into the mouth, the uvula and tonsils will be observed to be
swollen, and the back and sides of the pharynx and half arches to have a
peculiar dark mottled appearance, more or less of the tint of copper, which
is quite characteristic. These mottled spots rapidly take on ulceration, and
then present many of the peculiarities of the primary sore; thus the ulcers
are unhealthy in their appearance, disposed to spread, and sometimes rap-
idly become phagedenic, speedily destroying not only the uvula, but the
whole soft palate, or traveling forward make oftentimes a direct communi-
cation in the roof of the mouth, between the mouth and nose. Symptoms
of inflammation in the mucous membrane of the nostril may also present
themselves, and be shown by an increased discharge from the nose, which is
acrid, and excoriates the sound skin with which it comes in contact. As
the inflammation progresses, it next attacks the periosteum of the spongy
bones of the nose, so that caries of these and the neighboring bones is often
induced, from which proceeds the usual stinking discharge of diseased bone,
thus producing the affection designated as ozæna. As the caries progresses,
portions of the spongy bones are discharged with the pus, the nose becomes
flattened, the soft parts become involved, and ulcerate, and are completely
destroyed, so as to make a horrible deformity. With these symptoms con-
junctivitis and iritis are frequently observed, the changes produced by which
will be again alluded to under the Diseases of the Eye.

### ?  2.—Affections of the Skin.

At various periods after the appearance of a chancre, say about six or
eight weeks, but often independent of any affection of the throat and nose,
affections of the skin begin to be noticed, and these are first exhibited as spots
or taches of various kinds, like those of measles. These spots are reddish
in their color and about the size of a split pea or larger, appearing first, as
a general rule, on the skin of the face, on the palms of the hands, and then

upon the skin of the front of the chest, following in this respect the laws of eruptions generally. The light-red color which they present at first speedily becomes darker, and finally assumes that copper color which is regarded as characteristic of syphilitic eruptions. At other times any of the various skin diseases may appear; these corresponding with ordinary skin diseases in their general traits, though they are modified by their syphilitic source, and are hence called **Syphilides**. Thus we may have eczema or any other vesicular eruption; or any one of the papular affections; or those of the pustular class, these pustular syphilides being extremely pathognomonic, as they contain an amount of pus greater than usual, and are more disposed to dry and form crusts which are very prominent, being formed of scabs of several layers. When these crusts separate from the skin, a deeper ulceration is also left than is commonly found after the separation of a crust in the ordinary pustular affections, and this ulceration, in healing, leaves a depressed cicatrix, like the cicatrix of small-pox.

The pustular affections are very apt to attack the face, where they assume the shape of a circle, thus resembling some of the forms of porrigo, and when found around the forehead receive the appellation of the *corona veneris*.

Sometimes a tubercular disease of the skin is seen, by which term (tubercular) is here to be understood an affection presenting large pimples, from the size of the end of the little finger to the size of the end of the thumb, these being caused by a deposition of lymph beneath the skin. These pass, among the unprofessional, under the name of bumps, and are not unfrequently found upon the face.

The syphilides most frequently seen in the United States, according to my observation, are of the erythematous, vesicular, papular, pustular, and scaly varieties; as erythema, ecthyma, rupia, lichen, psoriasis, and lepra.

Fig. 165.
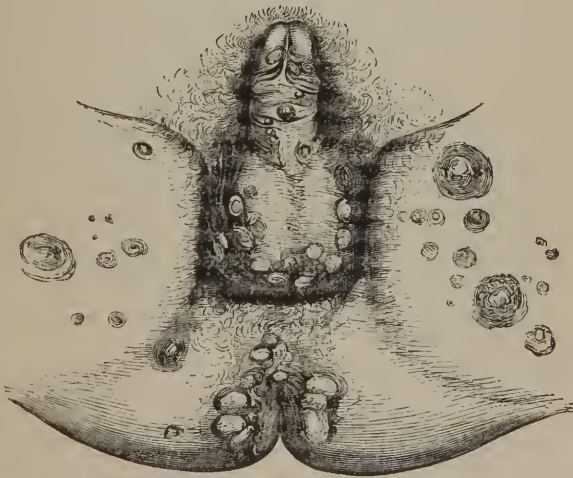


A full view of numerous Condylomatous Tumors as seated around the Anus and Genitals of the Male, though found also in the Female. (After Acton.)

These various skin diseases cannot be here described in detail; suffice it to say that they are more marked in character than the ordinary skin disorders, and are darker in color. In addition to affections of the skin we

may also have affections of its appendages, as the hairs and nails, the follicles of the hairs becoming impaired in their vitality and the hairs dropping out, so that the individual becomes bald. His eyebrows also not unfrequently fall off and he presents the condition known as *alopecia.*

Occasionally the growth of warts will also be noticed as a result of venereal contamination, these warts being precisely similar to those which follow gonorrhœa, requiring the same treatment. Condylomatous tumors are also found upon various portions of the skin, presenting elevations of the skin or mucous membrane, as described in connection with epithelioma. A very common seat of these condylomatous tumors is around the anus, where they show themselves frequently quite numerously, and in sizes varying from the tip of the finger to that of the thumb, or even larger, Fig. 165.

As the details of the syphilides are very extended, they would transcend the limits of this work. The reader is therefore referred to various treatises by dermatologists, and especially to the work of Cazenave and Schedel, as edited by Dr. Bulkley, of New York, 2d edition, 1852, this being a simple and well-arranged elementary work on these important affections.

**Treatment of Secondary Syphilis.**—When a patient presents himself laboring under the catarrhal affection, which, so far as the throat is concerned, is the first evidence of constitutional infection from the syphilitic poison, he might be supposed to be suffering under a simple pharyngeal irritation as the result of cold, or of the excessive use of tobacco. But the history of the complaint will generally undeceive the surgeon. Besides the history of the disorder, the diagnosis will also be influenced by the fact that these simple inflammatory affections produce a diffused redness, which, although it may be dark, has not the peculiar mottled appearance of the syphilitic complaint. In this stage, however, the local treatment of both forms is precisely similar, and the surgeon may therefore direct the use of some astringent gargle; such, for example, as sage tea and honey, with the addition of a little borax or alum; or a much better application may be found in a strong solution of nitrate of silver, fifteen or twenty grains to the ounce of water, thoroughly applied with a camel's-hair pencil. If the disease has progressed still further and resulted in ulceration, so that the back of the pharynx or uvula, or the sides of the tonsils are affected, they should also be frequently touched with a camel's-hair pencil dipped in a strong solution, ʒj of nitrate of silver to f ʒj of water. Between the cauterizations the patient may also use a gargle of vinegar and water, of alum-water, or some similar article, and should be put under appropriate constitutional treatment, the details of which will be given subsequently. The ulcers upon the tonsil or uvula should not, however, be confounded with the little adherent patches of lymph or mucus which are sometimes seen as the result of an ordinary pharyngitis, and which can be wiped off by means of a dry camel's-hair pencil, a manipulation which should always be practiced upon an ulcer in this situation before cauterizing it.

If the disease has progressed still further, and *ozæna* is presented, it is to be treated, so far as local applications are concerned, as ozæna produced by any other cause. Some detergent and astringent wash may, therefore, be used as an injection, and when the odor of the discharge is very offensive, it may be corrected by means of some of the chlorides, as ʒss of chloride of lime, or the same quantity of Labarraque's solution of the chloride of soda, being put into four ounces of water, and gradually increased in strength as it is used, until, when injected into the nostril, it creates smarting.

The local treatment of *affections of the skin,* or the *Syphilides,* is to be conducted upon the same general principles as are applicable to the diseases of the skin when they proceed from other causes. In cases of vesicular

eruption, if there is evidence of inflammatory action in the part, it must be overcome by warm mucilaginous baths, some alterative being given, and an alterative or astringent ointment applied, such as the following :—

> R.—Hyd. chl. mit. ʒij ;
>     Plumb. acet. grs. xv ;
>     Axungiæ, ʒj.   M.
> S. Anoint the part.

A similar plan is to be followed in the papular eruptions; but here, instead of the warm baths, vapor baths can often be advantageously used ; and, if no more convenient mode of obtaining it is at hand, a vapor bath may always be prepared extemporaneously by wrapping the patient in a blanket, within which hot bricks covered with wet towels are placed.   This may be repeated four or five times weekly.   If the patient has any of the pustular diseases just alluded to, or any of the scaly affections, such as psoriasis or lepra, or even ichthyosis, they should be treated in the same manner as similar affections of a non-syphilitic taint.   The scales or scabs of these syphilides may always be removed by means of some alkaline ointment, and a very good one is as follows :—

> R.—Sodæ carb. ʒss ;
>     Axungiæ, ʒj.
> M. et ft. unguentum.

The ulcer left after the scab or scale is removed may then be treated with weak red precipitate ointment, or with the alterative ointment of calomel, as before stated.

As regards the constitutional treatment of secondary syphilis, it should ever be borne in mind that it is to be conducted upon general principles. Let us get rid of the pernicious idea that in syphilis it is necessary, in order to remove one poison from the blood, to introduce into it another.   General principles are here all that is essential, and when alteratives seem necessary, let them be prescribed precisely as though the disease arose from any other cause, such means being employed as would be resorted to in similar conditions from other sources.

When a gentle alterative is indicated to modify the condition of the blood, as well as the capillary action of the skin and mucous tissues, as, for example, when the eruption on the skin begins to appear, or when the throat is first affected, the most judicious article that can be employed is the iodide of potassium, in doses of from three to eight grains, three times a day, and given in solution in water, in sirup, or in the compound sirup of sarsaparilla.   This salt; it is well known, is often administered in enormous doses, but there is no evidence of increased usefulness, while not unfrequently it seriously impairs the powers of nutrition, and, like all stimulants, when carried too far, is liable to be followed by serious depression.   It should also be remembered that the iodide of potash will, if carried to excess, produce an eruption or sore throat, and an irritation of the salivary glands, which looks not unlike that which is the result of salivation, as I have repeatedly noticed. For this reason, large doses, and a too persevering use of the drug, should be avoided.

Iodide of potash is classed by therapeutists among the "Alteratives," an indefinite class, whose action, not being fully understood, is explained in various ways: "Thus, they may change the condition of the blood, and do so, either chemically or dynamically, that is, in the former case by taking something from or adding something to this fluid, or in the latter case by operating on the vital susceptibilities.   Another mode is by modifying the

state of the tissues."* In most instances I have found iodide of potash a stimulant, materially increasing vital cell action, and thus favoring the removal of matter exterior to the tissue cells. By this stimulus of the tissue cells the circulation of the skin and mucous membranes is increased, and when this is carried to excess we note the congestion in the blotches and pimples seen on the skin, and in the irritation and increased secretion of the salivary glands of the mouth and throat, after the extreme administration of the remedy. Where congestion of these tissues has supervened on the blood poisoning of syphilitic virus, the increased activity developed by the use of alteratives materially aids the eliminating process, if medicinally it is not carried to excess. In this principle all alteratives act alike, mercury, arsenic, and iodine, with their compounds, being thus efficient in eliminating noxious material from the blood, when they are employed in moderation. In larger or too long continued doses their stimulating action may and does become a serious source of disease, developing local and general irritability of a marked character, and their poisonous effects are therefore to be guarded against.

With a correct view of the action of alteratives, mercurials and arsenic may, under certain circumstances, be judiciously substituted for or combined with iodine, care being taken not to resort to such stimulants during the active stage of mucous or cutaneous hyperemia, as seen in secondary syphilis; while in the more chronic forms these alteratives may be as usefully resorted to in syphilis as in tuberculosis, cancer, or general inflammation. Some of the special circumstances under which we should be justified in administering mercury in syphilis are: old cases of Hunterian chancres with indurated bases, which remain indurated from improper treatment in the early stage; or cases of *dry, scaly* eruptions in the skin, with *chronic* ulcerations of the throat, *not disposed to phagedena ;* nodes, etc.

The question whether mercury could be judiciously administered in syphilis is one which, in former times, excited much discussion, and which is still debated. But at present it is the opinion of many surgeons, and it is certainly my own, that in the cases just alluded to, alterative doses of mercury may be given with advantage, for the same reason that they would prove useful in any disorder of the digestive organs or in other diseases of the skin and bones, they being, however, always suspended so soon as the patient experiences the slightest disposition to tenderness about the gums.

The idea of the necessity of salivation in syphilis has, it is hoped, very nearly passed away, though formerly such a course was considered essential to its cure; and many can doubtless recall the horrors of some of the public institutions of Philadelphia, when mercury was given for the purpose of salivation in the syphilitic wards. Then it was not uncommon to see patients leaning out of their beds, with their heads over basins, their tongues lolling out, parotids swollen, and the saliva running in a stream, simply because they had syphilis; thus literally carrying out the idea of old Boerhaave, that "unless the patient could be made to spit four pounds a day, he could not be cured."

When it is desired to obtain simply the effects of an alterative, and the iodide of potash does not prove sufficiently stimulating, we may give Donovan's solution, or the liq. hydrargyri et arsenici iodidi of the Pharmacopœia —this being a solution of the iodides of mercury and arsenic—in doses of five drops twice a day. If this is found to produce irritation of the digestive organs, as shown in diarrhœa, etc., it may be omitted for a day or two, and recommenced when the system has recovered from its bad effects. At the same time, diaphoretics should be steadily given ; or the protiodide of

* Wood's Therapeutics, vol. ii. p. 229.

mercury administered in doses of $\frac{1}{4}$ to $\frac{1}{2}$ gr. twice or three times a day. By these means, we will generally get rid of the symptoms; while, if the patient is salivated, or these remedies long continued, the constitutional effects of mercury, as shown in perversion of nutrition, will be superadded to those of the syphilitic disease, and the patient suffer for years, particularly if he has a tendency to the tubercular diathesis. The indiscriminate use of mercury in syphilis is objectionable, but there are cases in which its judicious use, on the general principles just referred to, is a valuable means of regulating the progress of this affection.

If mercury has been *incautiously* given, the best way of checking its excessive action is by the use of the iodide of potash, which will eliminate the mercury from the system. At the same time, the alterative effect of the iodide will be obtained.

In thus admitting the value of the judicious administration of mercury as an alterative, and in connection with the other alteratives previously stated, in certain forms of secondary syphilis, and especially the scaly or tubercular affections of the skin, the author desires to be distinctly understood as advising its employment only to meet such indications as would justify its use without the suspicion of a syphilitic taint. For more than twenty-eight years he has seen all forms of syphilis more readily cured without mercurialization than was the case where it was freely employed. To show briefly his views of the pathology of secondary syphilis and the plan of treatment he prefers, he offers the following summary:—

The symptoms of secondary syphilis are the evidences of a natural effort to eliminate a poison from the blood by the skin and mucous membranes. This natural effort should therefore be favored by the employment of warm baths—the simple vapor bath and the sulphur or iodine vapor baths being resorted to—according to the redness and congestion attendant on the skin disease. Diaphoretics acting on the same principle are also highly useful. When in the pustular or scaly varieties the scabs are thick and hard, or the scales very dry, alkaline ointments, or a scruple of the carb. of sodæ, to an ounce of lard, will soften them and favor their removal. Then mucilaginous baths, or mucilage cloths covered with oiled silk so as to furnish heat and moisture, will favor the cicatrization of the ulcers or the proper secretion of the skin in the scaly class of these affections. As in all skin diseases it is important to employ purgatives and diuretics at an early moment, in order to remove from the blood matter that the diseased action prevents from passing by the skin emunctories; so in the syphilides, a similar treatment will be most judicious. The close connection naturally existing between the skin and mucous membranes inducing, when the skin is affected, disorder of the mucous membranes, and vice versa, certainly renders the administration of internal alteratives and stimulants sometimes highly serviceable; and with this view, arsenic, iodine, mercury, and their compounds will often so modify the tegumentary circulation as to aid the cure. On the same principle, any of these articles may be demanded for the relief of the syphilides. But when any of them, that is, either arsenic, iodine, or mercury, are given in such doses as will create general irritation, they will be found to be injurious. In some instances, as those cases of feeble digestion, congested liver, and alkaline urine, sometimes noted, the nitric or nitro-muriatic acids will prove of more service than any of the first-mentioned alteratives. Indeed, a careful analysis of the urine in secondary syphilis, as in other cases, will often suggest the best remedy, its beneficial effects being noticeable through the urine.

When, either from salivation or long-continued syphilis, the digestive organs are weakened, and the general nutrition impaired, chalybeates, bitter tonics, quinine, and cod-liver oil, with a generous diet, will be essential to the cure.

From these statements, it will, it is hoped, be admitted that secondary syphilis, like other disorders, is to be cured rather by attention to the symptoms than to the name of the disorder.

The important pathological condition to be overcome in syphilis is the tendency to a depraved local and general nutrition, and any remedies that impoverish either the local or general circulation will predispose to the extension of the diseased action.    Hence, under the free mercurialization of former times, the so-called syphilitic destruction was so marked.

The question of the advantage of resorting to mercury in the treatment of syphilis is one that has for many years been freely discussed by able exponents of the facts cited on each side of the argument, the weight of the testimony being with the non-mercurialists.    Thus:—

Sir James Macgregor stated in 1818, as the unprejudiced statement of the British regimental surgeons of that day, "that the average period of *primary* symptoms, *without* the administration of mercury, was 22 days; *with* it, 33 days."  "That the average cure of *secondary* symptoms, *without* mercury, was from 28 to 45 days; *with* mercury, 50 days—these observations embracing the result of nearly 5000 cases."

Desruelles, in 1312 cases, found the mean duration of *secondary* syphilis, *without* the administration of mercury, to be 32 days; *with* its use, 50 days.

Fricke states that the average period of cure in 1649 patients, *without* mercury, was 51 days; *with* it, 85 days—relapses being more frequent and secondary symptoms more severe when mercury had been given.   He reports 5000 cases treated without mercury, and has yet to see cases requiring its use.

Guthrie thinks every ulcer of the genitals is curable without the administration of mercury.

Carmichael rejected mercury as a dangerous and deceptive remedy in every variety of the disease.

Newbigging, of the New Town Dispensary, Edinburgh, reported, in 1847, 600 cases of venereal treated *without* mercury.

Sisovics, of Vienna, in 1848 reported 800 cases cured *without* mercury.

Norris, of Philadelphia, reported that in twenty-four years he had never administered mercury to a syphilitic patient, except when indicated by complications independent of the venereal disease.

Bennett, of Edinburgh, reports[*] "that in the various hospitals of Sweden 40,000 cases had been under treatment, one-half by the simple and one-half by mercury, the proportion of relapses in the first class—*without* mercury—being $7\frac{1}{2}$ per cent., and in the second class—*with* mercury—$12\frac{2}{3}$ per cent."

"In the various reports now published more than 80,000 cases have been submitted to experiments, by which it has been perfectly established that primary syphilis is cured in a shorter time, and with less probability of inducing secondary symptoms, by the simple than by the mercurial treatment."[†]

The prevention of syphilis has been attempted by inoculation, on the principle of inoculation in the preservative treatment of small-pox, under the name of **Syphilization**, in both Italy and Norway.   The results have been unsatisfactory, while there are powerful moral objections to its employment by the profession.

**Is Secondary Syphilis Contagious?**—A question that has lately excited considerable public and professional interest, is whether secondary syphilis can be communicated by inoculation to one who has not had the primary sore.  For many years this question was regarded as settled in the negative,

but recent facts have changed medical opinion, and especially that held by M. Ricord.

In October last, the minister of public works, in France, submitted to the Academy of Medicine of Paris the following questions:—

"1. Are there any evidences of secondary syphilis being contagious?

"2. Regarded as contagious, are the effects in infants at the breast different from those observable in the adult?"

"These questions were referred to a committee composed of Messrs. Gilbert, Velpeau, Ricord, Devergie, and Depaul, who reported through M. Gilbert, at the session of May 31, that—

"1. There are secondary or constitutional symptoms of syphilis manifestly contagious. At the head of these it is necessary to place the mucous papule or flat tubercle of the skin and mucous membranes.

"2. This proposition applies to the nurse and the infant at the breast as well as to other subjects, and there is no reason to suppose that in the infant at the breast the results of these symptoms have properties different from those observed in the adult."

The importance of these answers will doubtless be admitted in all communities, but especially in Paris, where so few mothers suckle their offspring.

If it is thus proved that a child at the breast can be inoculated by sucking a nipple that is slightly fissured in a woman with secondary syphilis, so is it acknowledged that a child born with syphilis can give the disease to the nurse who never had it—provided it has a mucous tubercle or ulcer of the mouth, and the nurse has an abrasion of the nipple, or the reverse. Medical men cannot therefore be too careful in examining wet nurses, nor in putting a child, who is syphilitic, to be nursed by a healthy woman—heavy damages having been recovered in England against those whose opinions have thus led healthy women to become infected. In these cases of inoculation from the secondary sores, there is no change in the laws noted in the creation of the primary inoculation, viz.: that the fibrin or virus must previously exist, and then be introduced beneath the cuticle, by an abrasion or some other cause, whence it is absorbed. The simple spots and scaly skin diseases have not, as is well known, ever produced inoculation. When a sore is produced by inoculation from secondary matter, its treatment should be prompt, and similar to that advised in chancre.

The question has also been raised whether an ovule, contaminated by the procreation of a man laboring under secondary syphilis, can inoculate the mother while the fœtus is in the uterus. In support of the affirmative, some few cases have been reported. But when we recall the difficulty that has long existed, of proving, by delicate chemical injections into the blood-vessels, that there is any vascular connection between the fœtal and maternal vessels, and when we recall the difficulties attendant on a correct observation in establishing the fact that neither parent had inoculated the other, it is best to await further investigations, though the surgeon should, as a measure of precaution, while there is a doubt on this question, caution a man recently suffering from secondary syphilis from completing a matrimonial engagement for some months after he seems to be free from disease.

**Syphilis in the Infant.**—The infant may be born with secondary symptoms of syphilis, be inoculated with a primary sore in its passage through the mother's organs, or subsequently by her fingers, lips, or nipple, or it may suffer from the earliest moment as the result of impregnation of the ovum in a diseased parent.

When a man, recently the victim of syphilis, impregnates a healthy woman,

or when a woman, recently affected with syphilis, is impregnated by a healthy man, the ovum may exhibit the effects of the contamination.    Hence many women abort at an early period of pregnancy, who, after the poison has been eliminated, will again bear healthy children.    Thus, also, the first impregnation by the man may produce a blighted ovum or a badly-nourished infant, or one emaciated and blotched at birth, while the parent may subsequently procreate healthy children.    In the present state of our knowledge, it should therefore be recollected that a marriage contract should (if it can be prevented) not be consummated until either party, if previously diseased, is entirely cured, and that the child, when born with syphilis, should be thoroughly and promptly nourished and its powers of life augmented, while, at the same time, the elimination of the poison from its blood should be favored by the means heretofore advised for the relief of secondary syphilis in the adult.

Reviewing now the subject as studied to this point, we must admit that the general influence of the syphilitic virus is to impair cell action and nutrition. In the primary sore it is shown locally.    In the constitutional disorder it is seen in the general powers of life ; and in the impregnated ovum and new-born infant it is similarly seen as characteristic of the want of proper force in the original cells furnished by the parents, or either of them, in the act of impregnation.    As the features and mental peculiarities are transmitted in this act, so it would seem is the evil influence acting on the blood of those who furnish the germs, a minuteness of action that is wonderful evidence of the power of cells in modifying the subsequent action of the elements of every tissue or organized body.

## SECTION III.

### TERTIARY SYPHILIS.

The symptoms of modified nutrition shown in the osseous and fibrous tissues, as the result of syphilitic contamination, are noted in the periosteum, bones, and ligaments, as seen in nodes, neuralgic pains, abscesses, ulceration, and death of the bones, and are classified under the general head of **Tertiary Syphilis.**    As they, however, do not differ materially from such disorders arising from other causes, and are amenable to the general principles of treatment already described under the head of Secondary Syphilis, their consideration will be reserved until the Diseases of the Bones are alluded to.

# CHAPTER IV.

## SPERMATORRHŒA.

AFTER studying the evils resulting from improper sexual intercourse, we may pass to the consideration of a complaint which not unfrequently modifies the general nutrition in consequence of the digestive derangement that accompanies it, and proves a great annoyance both to the patient and surgeon. Much obscurity has also been thrown around this subject by the misapprehension of honest observers and the mental distress of patients created by the duplicity of quacks.

**Spermatorrhœa** is a term the derivation of which—σπερμα, sperm, and ρεω, I flow—points out one of the most marked symptoms of the complaint, to wit, an apparent flow of semen, which shows itself at frequent and short intervals, and is the result evidently of a morbid irritability of the organs. To understand readily some of the conditions which may create emissions, it should be remembered that the rectum passes directly in contact with the vesiculæ seminales and the prostate; the latter, when enlarged, not unfrequently encroaching upon the cavity of the gut, so that hardened feces passing along the rectum, and pressing upon the prostate and vesiculæ, may lead —particularly when these organs are enlarged and irritable—to an apparent seminal discharge, which, accordingly, in persons of costive habit, etc. is not unfrequently found to take place during efforts at stool.

This complaint is a very ancient one, and not, as has been asserted in some works upon the subject, a disease of modern origin. It is distinctly alluded to in Leviticus in contradistinction to gonorrhœa, and is also described by Hippocrates. In more modern times, we find mention of it made by Wiseman in 1782, and by Frank, and others.

It has, however, been very carefully studied by Tissot and Lallemand, of Montpellier, in France, and their names, with that of Curling, of England, are at present closely associated with the subject. If the evils so minutely described by these and other European writers are commonly seen in Europe, it is certain that they are seldom if ever known in the United States, or at least they have never come within the observation of the author, who, though frequently meeting males who have suffered from spermatorrhœa for years, has never noticed the extraordinary results seriously ascribed to it.

Lallemand mentions this complaint as existing in two forms: one in which the emissions take place during the night, which he designates as **nocturnal emissions,** or **nocturnal spermatorrhœa;** and one in which they take place during the day, which he designates as **diurnal spermatorrhœa.** Now either of these conditions may exist to a certain extent without constituting a diseased action or creating any results which are injurious to the patient; and if this fact could only be impressed upon the mind of the latter, a great

amount of mental distress and one of the most marked evils of the disorder would be avoided, as it is very common for patients to labor under the greatest anxiety on account of their belief that they have spermatorrhœa, who have nothing more than a perfectly natural emission; and it is easy to see how this may happen: A healthy man, in whom the vesiculæ seminales are full, and who has no sexual intercourse, will not unfrequently suffer from more or less turgescence of the organs of generation, accompanied with some dullness of the ordinary train of thought, while there will be more or less tendency to thoughts about coition.    Under these circumstances nature will frequently relieve him by creating a seminal discharge during the progress of a lascivious dream; or during the day, he may go to stool, and his bowels being constipated, the pressure of the hardened feces upon the vesiculæ and prostate gland will lead to a mucous discharge, accompanied by an erection more or less complete.    This flow under these circumstances generally contains a large quantity of prostatic fluid and a smaller number of spermatozoa than that which is perfectly natural, and so far from being evidence of disease is really a proof of vigorous health and a full performance of the functions of the testicle and its adjacent organs.

That such a diurnal discharge is perfectly natural, may, I think, be inferred from the fact that a similar emission not unfrequently occurs under the same circumstances in the dog, this animal being often seen when straining at stool to have a discharge from the urethra; while the same thing takes place under certain circumstances of excitement in the stallion and in the bull.    Such emissions, therefore, if occurring but occasionally, say once in a week, should be looked upon merely as an effort of nature to get rid of the surplus of a secretion, and not as in any way injurious to the patient, but on the contrary a wise provision for the relief of his brain.

With regard to nocturnal emissions, when they do not occur more than once in ten days, or in two or three weeks, they also, if the individual is otherwise in good health, should be regarded as a perfectly natural result; but if the discharge happens two or three times in a night, without erection or with very imperfect erections, then the condition should be looked upon as a morbid one requiring treatment, lest in the sequel it lead to debility of the organs from excessive stimulation, though from a very extended observation I believe this to be a rare result.    In fact, were it not for the mental distress of patients, their cure might safely be left to nature, the disorder, when at the worst, demanding only the relief of local irritation when found, and a general invigorating plan of treatment, provided the habit of masturbation or lascivious thoughts is checked.

Etiology.—The causes which may result in the production of this complaint are very varied, and may act directly upon the brain and spinal cord, or be purely local in their character; thus, it may be produced by masturbation; by stricture of the urethra; by the presence of worms in the alimentary canal, particularly of ascarides; by congenital phymosis; by irritation in the prostate and vesiculæ; or by the congestion of these parts, which may be caused by too long sitting, as in the case of students and others leading sedentary lives; or it may be due to excessive exercise on horseback.    Of all these causes the most common, however, is certainly masturbation.

By masturbation, especially in extreme youth, so irritable a condition of the urethra and vesiculæ seminales is established that emissions may be brought on by reading lascivious books, by loose conversation, or by indulging in lascivious ideas; or may occur totally independent of any such causes.

In investigating the symptoms of spermatorrhœa, some light will be thrown upon their etiology by remembering that the irritation, which is at first local from the excitement thus created in the genital organs, is soon extended to

the spinal marrow, from whence these organs derive their nerves, as well as to the brain; whence it is communicated to the sympathetic system, and creates all that train of phenomena which may be described as follows:—

Symptoms.—At various periods after the establishment of the efficient cause (masturbation) and the occurrence of the emissions, the latter become more frequent, and the patient experiences a sense of fatigue, particularly in the morning, when he awakes from a sleep which has been broken by a nocturnal discharge. At night he also becomes restless, and in the day is sleepy and heavy; is melancholy, cowardly, and anxious about his health, often so much so that the surgeon will be astonished at the accuracy and minuteness of his observations upon his own condition. In addition to this, he not unfrequently has a dogged, downcast expression, and is unable to look any one in the face, while his features become emaciated, and his eyes sunken, and with dark lines beneath them. At the same time symptoms of nervous disturbance will be observed, the patient complaining of irregular pains in the back, stomach, and limbs. There is also irritation felt during micturition, and when derangement of the digestive organs appears, a train of symptoms is developed which very much resembles those produced in the female by prolapsus uteri, or by irritable uterus; the patient suffering from loss of appetite, while troubled with flatulence, and hearing "the wind rumbling about in his bowels;" he sometimes also has a suffocating sense of stricture in his œsophagus, often amounting to a true globus hystericus, and has a true salivation resembling the condition of the pregnant woman, and described as "spitting fips," that is, spitting small pieces of thick, tenacious mucus or lymph mixed in the saliva, which assume, when they strike the floor, the appearance of a small coin. To get rid of this matter the patient keeps up a continual hawking, which resembles that which occurs in secondary syphilis, while he suffers from water-brash, and has not unfrequently nausea or morning sickness resembling that which occurs in the female during the first months of pregnancy.

The pulse is sometimes quick, irritable, and peculiar—so much so that, after some experience, the surgeon will frequently guess at the disease simply from the pulse, as it resembles no other pulse except that resulting from the excessive use of tobacco, being a quick, irritable, windy pulse.

There is often dyspnœa, which is sometimes quite severe, especially after ascending a flight of stairs; there is pain in the chest, and a tickling in the palate, which is not unfrequently due to elongation of the uvula; while he expectorates freely, and imagines that he is going into a consumption. All these symptoms, though annoying to the patient, are in no way dangerous to life, and should be looked on simply as due to nervous derangement. That the cerebral functions are deranged, is evinced by various symptoms; thus, the patient does not sleep soundly, and is subject to nightmare; cries out in his sleep, is restless, and has troubled dreams. He also suffers from vertigo, ringing in the ears, deafness, and irregular action of the optic nerves; vision being impaired, and motes floating before the eyes, etc. As evidence of the mental disturbance, a change in his disposition will be noticed, particularly if the disease is the result of masturbation, the passions in this latter case being misdirected; he is no longer satisfied with the female, but turns aside from the most attractive, and prefers the practice of masturbation to the pleasures of the sex. He, therefore, usually shuns the society of women, prefers solitude, and is melancholy and reserved. The nervous derangement is also shown by its effects upon the other functions; thus, the urine presents abundantly those phosphatic deposits which are generally found in any case of irritation of the digestive organs, while it also is alkaline, contains more or less mucus, and a few spermatozoa.

**Diagnosis.**—The diagnosis is easy, the patient generally admitting the condition when closely questioned, though probably denying the cause.

**Prognosis.**—The prognosis of this complaint must necessarily be guarded, as there is no disease so difficult to cure, or one which presents less certainty as regards the result of the treatment.

This uncertainty is necessarily the result of our want of knowledge of the true pathology of the complaint ; *post-mortem* examinations having shown nothing very definite, ulceration or even irritation of the urethra having been rarely observed ; while inflammation of the vesiculæ seminales, and inflammation and abscesses of the prostate gland, with congestion of the spinal marrow, congestion of the cerebellum, irritations of the mucous membranes of the throat and stomach, have been noted when there was no spermatorrhœa. It is also difficult to form a correct prognosis in a disorder that is so closely attended by evidence of mental aberration rather than corporeal disease.

**Treatment.**—The treatment of spermatorrhœa may be divided into three heads—1. The moral treatment. 2. The local. 3. The constitutional treatment. In the moral treatment the physician must be aided by all the knowledge that he can gain of the character of his patient. If he is depressed in spirits, or if he is anxious about his health, he must be freed from the idea that the discharge from which he suffers is acting as a drain upon the system ; an idea which always alarms and depresses him, and one of which he should be promptly disabused, by telling him that the loss of a drachm or two of semen, daily, cannot possibly be attended with such terrible consequences as are attributed to it, though he generally thinks he is fully posted on this subject from having read the accounts of those who prey on society by magnifying the evils of this disorder, and forwarding their lying pages to all sections of the United States. Having thus consoled him as much as possible, and in a measure relieved the mental derangement, all causes competent to produce a disordered condition of the parts should be removed ; and if he has been practicing masturbation, it must be given up. Let him be convinced of the impropriety of the practice ; let him endeavor to check every unchaste thought ; let him abstain from reading lascivious books, etc. etc., and much will be gained toward the cure of this most annoying mental and physical malady, by means which have been correctly designated as the moral treatment.

The local treatment consists in such measures as would be adapted to local congestion, or neuralgic irritations elsewhere. When the condition of the parts is simply a congestion along the canal of the urethra, as will be shown by the pain caused on passing a bougie into the bladder, it may often be very much if not entirely removed by the occasional distention which results from frequently carrying a bougie of wax throughout the canal, and especially through its vesical portion. When the instrument is introduced under such circumstances, a considerable degree of tenderness will often be noticed between the bulb and the membranous portion of the urethra, or in the neighborhood of the prostate gland, this tenderness being there greater than it is at any other point. When it is excessive, inflammation in that region may be suspected ; and if this suspicion is confirmed by the fact that the simple passage of the bougie rather increases than relieves the irritation, Lallemand's instrument may be resorted to, for the purpose of lightly cauterizing the seat of the supposed inflammation or ulceration. In these patients, cauterization of the urethra is really beneficial ; and there are also cases of supposed impotence in which local stimulation by the caustic proves highly useful, by creating an irritation which is transmitted to the spinal cord, and results in erections ; but I am

satisfied, from considerable experience, that the universal and indiscriminate application of the nitrate of silver to cases of spermatorrhœa has done much harm, by developing a condition of extreme sensibility that did not previously exist.

If the discharge is the result of congestion and enlargement of the prostate gland, as is not unfrequently the case—and which has been well named by Prof. Gross, of Philadelphia, as Prostatorrhœa—it will contain much mucus but few spermatozoa, showing that it comes chiefly from this gland. This derangement should, therefore, be treated precisely as it would be under any other circumstances, and in these cases, blistering the perineum or the introduction of a narrow seton will sometimes prove highly useful. If the exciting cause is constipation, it must be relieved by laxatives and by injections of cold water into the rectum, which will not only aid in overcoming the want of action in the bowels, but serve to allay the irritation in the vesiculæ seminales and prostate gland.

In lunatic asylums, or among young lads, in whom masturbation is not uncommon, and whose mental condition is often such that we cannot control the practice by moral means, benefit will often be derived from a blister applied to the penis, which will make the organ sufficiently sore to compel the patient to let it alone, at least for the time, while the irritation is useful as a revulsive.

Advantage will also sometimes be derived from the use of stimulating diuretics, such as cubebs, copaiva, etc., while injections of calomel and mucilage into the urethra are sometimes beneficial, especially when the passage of a bougie develops acute pain. The following formula, for example, may be employed:—

> ℞.—Hyd. chl. mit. ʒss;
>     Muc. g. acac. fℨviij.   M.
> S. Inject once a day.

But this, like the caustic, is only applicable to those cases in which there is marked irritability of the lining membrane in the course of the urethra, the emissions ensuing on imperfect erections.

The general treatment of this complaint is, however, the most important, and is to be found in the use of such means as are calculated to relieve congestion of the spinal marrow and cerebellum; in tonics and other measures calculated to remove the digestive derangement, as quassia and iron, while cold douches may be applied to the spine, or blisters to the region of the cerebellum, etc.

Should the progress of the disease result in impotence, advantage will sometimes be derived from the use of nux vomica, according to the plan of Tissot, of Paris, from $\frac{1}{64}$ to $\frac{1}{48}$ of a grain of strychnia being given twice a day, and pushed till it begins to produce slight muscular twitchings precisely as would be done in an ordinary case of paraplegia, but using, if possible, greater caution. As regards the employment of stimulating articles with a view of producing erections in these cases of impotence, they may be set down as of little or no value, and sometimes prove positively injurious. The muriated tincture of iron is occasionally beneficial, but merely as any other preparation of iron would be by improving the condition of the blood; upon cantharides or upon phosphorus no reliance can be placed. This *idea* of impotency—for it is usually only an idea—is the most annoying symptom in the complaint; as individuals will not unfrequently be found who have had more or less of seminal emissions for years without giving it a thought; until having read some vile advertisement, or unprincipled book, and, perhaps, formed a contract of marriage, they become alarmed and consult a

surgeon in regard to their powers.    Under such circumstances, no one need hesitate about advising the completion of the contract, as a few weeks will certainly cure the patient.

That spermatorrhœa, even in extreme cases, is not usually followed by loss of memory, idiotcy, or even impotence, is a point on which personal observation has rendered me very positive.    At the Blockley Hospital there have been many cases, and in private practice I have met with very many gentlemen whose career I have noted, and I have yet to see the first one who subsequently suffered serious mental or physical disorder from spermatorrhœa, provided masturbation was not continued.    A very large proportion of the cases met with—and I have seen them from 15 years of age to 35, in all professions and occupations—have been cured by the treatment based on the general principles just stated, especially when moderate coition was possible, and the patient could be persuaded that his information as to the result of the affection was gained from sources entitled to no credit, and too often furnished solely with a view of benefiting pecuniarily by his fears and excited imagination.    If the law could eradicate the various publications specially addressed "to youth," "those contemplating marriage," etc., surgeons would be freed from the treatment of this distressing affection, and one that certainly exhibits a reasoning creature in a low yet pitiable condition.

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Spermatorrhœa, by L. A. Dugas, M.D. Georgia.—*South. Med. and Surg. Journ.*, vol. ix. N. S. p. 571.            1853.
Spermatorrhœa Rings: Cases Treated, by J. A. Mayes, M.D.   Sumter District, S C.—*Charleston Med. Journ.*, vol. ix. p. 351.            1854.
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* For other papers on Tuberculous Tumors and Strictures of the Urethra, see vol. ii. under the Disorders of Regions.

# PART IV.

## MODIFICATION OF NUTRITION CREATING TUMORS.

### CHAPTER I.

#### GENERAL CHARACTERISTICS OF TUMORS.

THE word Tumor (*tumeo*, I swell) has been employed by Boyer to designate "any preternatural eminence developed in any part of the body;" by Hunter, to express "a circumscribed substance produced by disease, and different in its nature and consistence from surrounding parts;" while Miller, of Edinburgh, applies the same term "to any morbid growth or new structure, which is the result of perverted nutrition in a part, unconnected with inflammatory action otherwise than as an exciting cause." These definitions, though not invariably correct, are sufficiently applicable to this class of growths, and expressive of the general views of surgeons as to their origin and development.

**Pathology.**—A considerable diversity of sentiment exists among pathologists in reference to the process by which tumors are developed, some regarding them as originating in the outpouring from the blood-vessels of a formless blastema that more or less closely resembles the liquor sanguinis, in which, by the law of free-cell development, nucleated cells originate, by whose transformations all structures constituting tumors are produced; while others, and especially Virchow, believe the transformation of tissue consists, in every instance, in a multiplication by division of cells previously existing in the part where the tumor is located.

**Etiology.**—The exciting causes of tumors are not definitely known. They are sometimes attributed to local injuries received previous to their development; but this notion is met by the statement of Paget, that "in a large majority of tumors no injury or previous local disease could be assigned even by the patients themselves as the cause of the growth. In 200 tumors taken indiscriminately from those lately recorded by him, no local cause whatever could be assigned for the growth of 155;" while, on the other hand, "it is an almost infinitely small proportion of injuries that are followed by these growths."*

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* Paget's Lectures, Philadelphia edition, p. 329.

**Effects produced by Tumors.**—Whether a tumor be benignant or malig-
nant, it generally produces some change in the surrounding parts ; thus, in
most tumors the surrounding connective tissue becomes indurated, lamellated
or cystiform, so as to surround them with a perfect sac ; the muscular struc-
ture is atrophied or hypertrophied, the first being the more common ; the
fascia is either increased or diminished in density ; the larger vessels thick-
ened or contracted ; the capillaries engorged and augmented in size ; while
the whole arrangement of parts is more or less displaced, in proportion to
the tension of tissue created by the growth of the tumor.   So varied, how-
ever, are the positions, structures, character, and modifying influences seen
in different tumors, that the surgeon will not err greatly in anticipating that
he will find a relative change of structure, when he attempts the removal of
most of them, and especially those covered by fascia or fibrinous expan-
sions.   Tumors thus situated, having their external development retarded,
press on the adjacent tissues, and give rise to thickening or thinning of
normal tissue, induce adhesions, displace blood-vessels and nerves, as well
as often create serous or fibrinous exudations and the agglutination of the
tissues involved.

**Classification of Tumors.**—In the various attempts that have been made
to classify the different varieties of tumors, writers have found it impossible
so to arrange them that the classification would be accurate.   Among the
older surgeons the terms fleshy, fatty, pulpy, honey-like, etc. designated their
appreciation of the sensible properties of each class.   Müller has more
recently divided them—according to their chemical nature, microscopical
characters, and mode of development—into fatty, jelly-like, and albuminous ;
while under the general head of "Organized New Growths," Rokitansky
places such changes of the areolar tissue as eventually produce a tumor whose
ulterior constitution is fibrous—the arrangement of the fibres and the de-
posits and changes occurring in it creating all the varieties of other writers.

Bennett, of Edinburgh, who bases his classification on a knowledge of
the compound texture of tumors, aided as far as their varieties by their re-
semblance to well-known pathological objects, places all the known primary
classes of morbid growths under the following heads :—

|       |           |    |               |
|-------|-----------|----|---------------|
| I.    | Fibrous   | growths | Fibroma.  |
| II.   | Fatty     | "  | Lipoma.       |
| III.  | Cystic    | "  | Cystoma.      |
| IV.   | Glandular | "  | Adenoma.      |
| V.    | Epithelial| "  | Epithelioma.  |
| VI.   | Vascular  | "  | Angionoma.    |
| VII.  | Cartilaginous | " | Enchondroma. |
| VIII. | Osseous   | "  | Osteoma.      |
| IX.   | Cancerous | "  | Carcinoma.    |

All these primary divisions he subdivides according to the presence of
particular substances or their fancied resemblances (as named by the old
surgeons) to other substances, as water, lard, brain, flesh, etc., as follows :—

|                |    |                |
|----------------|----|----------------|
| Hygroma        | like | Water.       |
| Melanoma       | "  | Black pigment. |
| Chloroma       | "  | Green    "     |
| Hæmatoma       | "  | Blood.         |
| Colloma        | "  | Glue.          |
| Steatoma       | "  | Lard.          |
| Atheroma       | "  | Gruel.         |
| Meliceroma     | "  | Honey.         |
| Cholesteatoma  | "  | Cholesterin.   |
| Sarcoma        | "  | Flesh.         |
| Neuroma        | "  | Nerve.         |
| Encephaloma    | "  | Brain.         |
| Myeloma        | "  | Marrow.        |
| Scirrhoma      | "  | Marble.        |

The terms *Fibro-cystic, Fibro-sarcoma, Osteo-sarcoma,* indicate the combinations of one or more elements; while *Fibroid, Cystoid, Adenoid, Chondroid, Osteoid, Colloid, Hæmatoid, Fungoid, Encephaloid, Myeloid, Cancroid,* etc., indicate tumors that have a certain resemblance to or partake largely of the character and substance named, but which are not in their nature *absolutely or altogether the same.*\*

As the tendency of some tumors is to degenerate rapidly and reappear when removed, either in the cicatrix or elsewhere, some authors describe these growths as *Malignant,* while those which seem less injurious, remain long unchanged, and approximate more to simple hypertrophy of tissue, are called *Benignant.*    As indicating the tendencies of certain growths, and the results attendant on their removal, such a division has a certain degree of utility, though the number of tumors that are thought to be benignant or malignant, with the decision of the question whether these growths are capable of such changes as would convert one into the other, is by no means settled.

**Origin of Tumors.**—The origin of tumors has long been a subject of deep interest to pathologists, and from the labors of many of them, especially Bennett, Rokitansky, Virchow, Wedl, and Paget, this subject has been much elucidated, and to these writers I am indebted for many of the facts and opinions presented in this portion of the work.

Tumors, being examples of morbid growth, originate chiefly from a modification of the local circulation, or increased cell action, or are the result of causes that act indirectly through the blood itself, and especially impoverished nutrition, as in tuberculous tumors.    Any local irritation, as friction, blows, etc., may so irritate the component cells of a tissue as to give rise to increased formative action, and a deposit which, while differing from that seen in simple hypertrophy, yet approximates it to some extent.

The peculiar character of a tumor is determined, generally, by the cell action of the tissue in which it is formed : thus, fibrous tumors are most commonly seated where the fibrous element predominates; and enchondroma, fatty, and osseous tumors are found in connection with cartilage, adipose tissue, and bone.    The special location of tumors is, however, influenced by other causes; thus, osseous growths in rheumatic constitutions are found at the extremities, while in syphilis they are met with in the shafts of the long bones.

**Growth of Tumors.**—Tumors once formed grow like normal structures, drawing their nourishment by cell action from the adjacent blood-vessels, as described under the head of normal nutrition, their development being accomplished in the following manner :    1st. The elementary cells are produced as in adult tissue, but they are either more numerous or larger than natural, preserving their normal relations and mode of arrangement, as in lipoma, adenoma, and angionoma.    2d. The cell action of the structure creates the same change in the tissue that is found in embryonic connective tissue, as is seen in fibrous and osseous tumors.    3d. The cells multiply and reproduce others so that their normal relation and mode of arrangement, as nucleus, nucleolus, and cell wall, are destroyed, as in enchondroma, epithelioma, and carcinoma.    As the growth of a tumor is due to cell action, or to vital organization, the greater the number of cells and vessels, the more rapid the progress which it makes, provided there is sufficient heat, moisture, and space to facilitate its development in accordance with histological laws; and a valuable hint in connection with the treatment of tumors is thus gained,

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\* Bennett's Lectures, American edition, p. 150.

cold, dryness, and diminished circulation checking the development, while heat and moisture favor the increase and degeneration of structure.

**Prognosis.**—The prognosis of the result of the removal of tumors, and especially those of a malignant character, should be guarded, in the existing state of our knowledge; every hope that can be conscientiously offered being presented in the latter case, in order that the digestion and general powers of nutrition and assimilation may receive the benefit of so important a men- tal stimulus, depression of spirits destroying the appetite.    Benignant tumors, though occasionally returning, are not apt to do so when once thoroughly extirpated.

The disposition of malignant tumors, after extirpation, to reappear near the original spot, as well as the tendency to their development in other parts of the body, has been so marked, that surgeons have for years thought it useless to operate for their extirpation, some maintaining that the irrita- tion of adjacent parts by the operation only hastened the destructive action of the growth.    This opinion has long been regarded as sound—extended statistics having considerably augmented the number of cases where the removal of carcinoma was followed by a reproduction of the diseased action.

Instances of the recurrence of tumors previously regarded as benignant have, on the contrary, created a belief in their malignancy, and recent physiological and pathological investigations appear to have developed facts connected with the prognosis of tumors, that leave the decision of the propriety of operating in those supposed to be malignant, unsettled. Many surgeons are, therefore, yet patient observers of the tendency of the facts daily accumulating, for the settlement of this much-disputed point. Fibrous tumors which were at one time thought to be entirely innocent, have so frequently returned that one class is designated by Paget as the "*recurring* fibroid tumor."    Sarcoma, as reported by Lebert, has been known to spread to various internal organs.    Lipoma, neuroma, cystoma, adenoma, epithelioma, and enchondroma are similarly described by Murchi- son, Walther, Velpeau, and others;* and Velpeau, in 1853,† cited numerous cases where scirrhus and even encephaloid tumors of the breast—whose charac- ters, by microscopical examination, were regarded as established beyond doubt, and where ulceration was established and the adjacent glands involved— were most successfully extirpated, the patients living, without a return of the disorder, from five to nine years subsequently.    If the influence of cell action, as described by Virchow, is admitted, the value of an operation will of course be great, especially if sufficiently extensive to involve the adjacent sound tissues, and thus thoroughly eradicate the diseased cells.    But herein lies the difficulty, multitudes of germs being often left, without there being any evidence of their presence at the moment.    According to Vanderkolk, as quoted by Bennett,‡ the propagation of tumors, and their reproduction, is the result of the infiltration of the neighboring tissues by the cell action of a tumor in process of development; a fluid being elaborated which min- gles with the parenchymatous substance around, and thus gives certain tend- encies to the evolution by which normal cell action and tissue is converted into morbid structure.    Hence tumors that are soft, pulpy, and contain a liquid or juice are most liable to return.    Without attempting to decide the general question of the recurrence of tumors, and the propriety or advant- age of removing them under certain circumstances, but rather continuing

* Bennett's Clin. Med., p. 203.
† Traité des Maladies du Sein.
‡ Op. citat.

to observe the results of daily experience at home and abroad, we must admit that, in view of the influence exercised by the cells of any tissue upon the development of a normal or abnormal growth, we cannot too strongly urge the importance—in all operations for the removal of tumors—of extirpating a portion of the adjacent and apparently sound structure rather than limiting the operation merely to the diseased growth.

It has hitherto been taught by many that even careful extirpation of a malignant tumor before any other part was attacked, would not materially check the progress of the disorder, the local diseased action being prone to reappear in or near the cicatrix, while some have even proved by statistics that life was shortened by an operation. At present the latter opinion is being re-examined, Bennett, Virchow, and Paget, with some others, having lately expressed doubts on the subject, believing that the presence of the local disorder is injurious by impairing the cell action of the adjacent tissues, ultimately impoverishing the general nutrition of the body by the drain it establishes, as well as by the mental and nervous irritation that the presence of the tumor occasions. Such an opinion is well worthy of serious consideration, owing to its bearing on the propriety of an early extirpation of a supposed malignant tumor, and may revive the practice of extirpating all cancers, though this was formerly not regarded as sound practice.

As the practical value of the study of tumors, as of all pathological changes, is to increase the means of relief and decide on the best plan of treatment, it is important that a correct knowledge of their general external characters should be obtained; and this may next engage attention.

**Diagnosis of the Character of Tumors.**—In diagnosticating tumors, the senses of sight and touch are those mainly required, though that of hearing may occasionally be called into play, in order to detect vascular disorders or connections.

**The Character of Tumors as taught by Sight.** — On looking at any tumor, its general shape and position should first be noticed. Tumors involving the glandular structures, and especially those of the lymphatic glands, will generally be seen to be nodulated or irregular, provided effusions into surrounding parts have not created such changes in the integuments as would equalize their surface. Those which are encysted or fatty are, on the contrary, more smooth on the surface, and globular. Pulsation, change in the color of the skin, as blueness or redness, together with a turgescence of the superficial veins, are also points that should attract the eye in this primary investigation.

**By the touch,** a judgment may be formed of the solid or fluid character of a tumor, of its hardness or softness, of its attachments to surrounding tissues, of its pulsations, and of its sensibility. Hardness will generally characterize albuminous deposits, the majority of which are called malignant; elasticity, amounting almost to a sense of fluctuation, characterizes the fatty class; while, unless the sac is very full, or the contents decidedly jelly-like, fluctuation and the presence of liquid may be readily told in the encysted. Occasionally, the position of a tumor, and its confinement by the fascia, give to it a sense of pulsation that might lead to the supposition of its being a vascular enlargement. Under these circumstances, an effort should be made to elevate it from the subjacent artery; or the circulation be stopped in the latter by pressure, while the change in the size of the tumor is noted; or the ear may be applied and the peculiar aneurismal *whir* heard. Some surgeons, in addition to these means, aid their diagnosis by introducing a grooved or cataract needle into the tumor, and noticing the character of the liquid that escapes, or the sensation of solidity given by the

passage of the needle.    When other means have failed, and a consultation are in doubt, or when the operator is prepared to remove the tumor at an early period, it may be useful to resort to this aid to diagnosis; but experience has induced the opinion that, as a general rule, the exploring needle is liable to abuse and to the creation of injury.    If the tumor prove to be malignant, its development will frequently be rapidly accelerated by such an application.

**Treatment.**—The treatment of tumors should consist in the employment of such means as will tend to retard their development, favor their absorption, or remove them mechanically.

It having been shown that the growth of tumors is the result of increased vascular and cell action in the part, and that heat and moisture, with room for expansion, favor their development, the general treatment resolves itself into the fulfillment of the indication of obviating these influences.    This may be accomplished by strict diet, by the local abstraction of blood, as by leeches applied *around* but not *on* the tumor; by evaporating solutions, by anodyne plasters and ointments, so as to diminish local irritation and create sedation, increase the perspiratory and local exhalant action, or by moderate compression, applied so as not to become a source of irritation.    In some cases, the ligation of a main blood-vessel will prove useful, though the development of the anastomotic circulation often eventually impairs the success of this treatment.    The removal of the mass may be accomplished either by chemical agents, like escharotics, which, by absorbing moisture, cause the death of the part and its subsequent separation under the process of sloughing, or by the action of the knife.    The opposition offered by many patients to the use of the knife, as well as the fact that morbid cell action in a tumor gives it less vitality than healthy tissue, and that, consequently, under the use of escharotics, it may be readily and thoroughly separated from the sound tissues, has induced many surgeons to think favorably, under certain circumstances, of the removal of some tumors by the latter.    But since the introduction of anæsthetics, the objections of patients to the knife have been, in a measure, removed; while the promptness of extirpation and its special adaptation to the removal of tumors in regions containing important and adjacent cavities and vessels, has certainly induced a large number of surgeons to regard operations by the knife with greater favor than treatment by escharotics.

As circumstances vary greatly in different cases, it will probably prove most useful to the reader to present a general account of both plans of treatment, and leave the decision of the advantages of one over the other plan of treatment to individual opinion.

**Escharotics.**—The safe removal of a tumor, by the use of an escharotic, requires—

1. That it should be so situated that the article employed cannot create ulceration in any important adjacent structure.

2. That means should be employed to mitigate the violent suffering that follows the application of the escharotic to tissues possessing normal sensibility, the pain resulting from the employment of caustics to the skin being usually greater and longer continued than that caused by the knife.

3. That attention should be given to the employment of such means, subsequently, as will favor the separation of the slough produced by the escharotic and the cicatrization of the ulcer that is left.

The application of caustics being mainly applicable to malignant growths, the account of their composition and use will be given under the head of Carcinoma.

**Operations for the removal of Tumors.**—In the treatment of a morbid

condition so varied as that seen in tumors, it must evidently be impossible to lay down any general mode of operating that would be applicable even to a majority of the cases that may be met with.   Surgical writers have, therefore, usually been satisfied with furnishing directions in regard to the form of the external incision, or in recommending that, in all operations for the removal of tumors, the skin should be so cut as to create little deformity, while, at the same time, the deep-seated attachments of the tumor should be freely exposed.   When compared with the increased difficulty liable to be caused by a limited incision, the inconvenience caused by the deformity from a cicatrix does not deserve a moment's consideration. Wounds of the skin, it is well known, generally unite with great facility, while a free incision, by enabling the operator to see distinctly the structures upon which he is acting, will greatly accelerate the accomplishment of his object, and save the patient much unnecessary risk and suffering.   From the importance of the parts often adjacent to tumors, the first object of the operator should undoubtedly be to accomplish the removal of the disease with safety and certainty; and nothing will aid this purpose so much as a free external incision, the subsequent dissection being, if necessary, more limited in its extent.   The choice of the shape of an incision will also often exert considerable influence upon the success of the operation; and a brief reference to the adaptation of each of them to special cases may, therefore, prove serviceable.

The straight incision is especially applicable to the removal of small and superficial tumors, or those situated directly beneath the skin.   The elliptical incision exposes a part more freely, and is chiefly resorted to when it is desired to remove an excess of integument, as in the case of a large or pendulous tumor.   The V incision is more free, and adapted to tumors of moderate size, so situated as to render it necessary to insure the safety of particular parts; while the crucial or the T, and especially the former, will be found the best in all cases where the tumor is large and likely to require a free dissection.

Large tumors, particularly those that are pedunculated or pendulous in their character, may be removed by making two simple semicircular, semilunar, or elliptical incisions.   Two incisions, formed in the shape of an L or a T, will give very free openings; but the freest will be obtained by making a simple crucial incision and turning back the four flaps.   As a general rule, all these incisions should be made from the circumference toward the centre of the tumor.

There are certain other rules which deserve to be remembered, a very excellent one being that laid down upon this subject by Dr. Alexander Stephens, of New York, to wit, to make the first or second cut of the knife pass down on to the tumor itself, this always being thoroughly done before commencing to dissect it out.   If this rule is not followed, the surgeon may wander off from the tumor into the surrounding healthy tissues.

Another rule is in regard to the manner of using the knife, which should be held like a pen, and drawn with long sweeps; for if the surgeon holds it so that the point can be used, and pricks at the bottom of the wound with short cuts, he may open a large artery, wound a nerve, or do some other mischief, which attention to this rule would have avoided.

The *entire* tumor should be removed, and none left if possible, as the patient will then be much less liable to a return of the complaint.

In order to control the tumor, it is a good practice to pass through it, at the commencement of the operation, a large needle, armed with a strong ligature, which, after the needle is removed, should be tied in a loop, so as to give the surgeon perfect hold of the mass to be extirpated.

When large vessels or nerves are in the neighborhood of tumors, they should be protected from the edge of the knife by holding them out of the way by a blunt hook.

In operations upon the neck, in which the large veins are involved, great care should be taken to prevent the entrance of air into these vessels.

Malgaigne also advises that the dissection should be made by extensive cuts—by which I understand the sweeping motion of a good dissector, and not the hacking and pricking of tissue occasionally seen—the edge of the scalpel being directed as much as possible from those parts which it is important to leave untouched, whether they be in the tumor or in the healthy structure.     In connection with the dissection, conducted in the neighborhood of important organs, whether nerves, vessels, or muscles, he also directs that they should be drawn or put to one side by means of blunt hooks, the fingers, or forceps.     When the principal portion of the tumor is removed, especially if it is of a suspicious character, the surgeon should endeavor to satisfy himself that no particle is left behind, lest it serve to reproduce the disease; and when any of the remnants are thus found, they should be removed either with the knife or scissors, the wound being left undressed until all the vessels are tied and the flow of blood arrested, when an effort may be made to heal it by the first intention.*     On this latter point surgeons have always differed, and in this case I must respectfully dissent even from such good authority as Malgaigne is generally admitted to be.     In tumors of any size above that of a walnut, union by the first intention will not usually be probable, especially if ligatures have been required, and individual observation has rather led me to the observance of the practice of Dr. Physick, and to the introduction of a little slip of linen at the inferior angle of the wound, so as to insure a vent for any pus that may be secreted.     The surface of an incised wound generally unites without difficulty; but the deeper-seated parts are more obstinate, and in the neck it is especially important that pus should be prevented from burrowing, and that a free vent should be guaranteed it by other means than those furnished by bringing the ligatures out at the lower angle of the incision.

In the extirpation of tumors about the neck, Langenbeck† proceeds as follows: He first makes a free division of the integuments, dissects the muscles from over the tumor, but avoids cutting through or injuring them if possible, thus making the tumor sufficiently movable, while, by preserving the muscles, he is enabled to know accurately the place of the chief blood-vessels. Then, when the surface of the tumor has been cleared, its separation is to be commenced on that side which presents the least risk, or where the least considerable vessels are, and the dissection carried from thence toward the more hazardous portions.     This distinguished surgeon has also recommended that the knife should not be introduced deeply where there are any large blood-vessels, but that the tumor should be strongly pulled outward, so as to separate it from the vessels, and put the connective tissue around them on the stretch.     The recommendation of traction will be found especially serviceable, and the operator will be well able to carry it out if he takes the preliminary step of passing a strong ligature deeply into any solid tumor immediately after incising the skin.

Directions like those of M. Langenbeck, though of a general kind, should be firmly impressed on the mind of every surgeon, when operating on tumors of this portion of the body, or indeed elsewhere.     But, though sufficiently useful, as far as they go, they do not furnish such an accurate account of the

* Malgaigne, Op. Surg., Philad. edit., p. 104.
† Cooper's Surg Dict., p. 377, by D. M. Reese, New York.

best mode of overcoming the difficulties likely to be met with in the removal of tumors from the course of the great vessels of the neck and other parts as is desirable. A selection of a few difficult cases has therefore been made, and will be hereafter presented in connection with special regions, with a view of furnishing a substitute for the individual observation of any young operator, viz., the experience of older surgeons.

Having thus alluded to the points of a general character in the study of tumors, we may next take up the consideration of each class separately.

# CHAPTER II.

## FIBROUS TUMORS—FIBROMA.

FIBROUS GROWTHS, or new formations of fibrous tissue, include many conditions not properly belonging to the category of tumors, as the tissue of cicatrices, of inflammatory indurations, of adhesions between serous surfaces, etc. In this place, however, attention must be restricted to those cases in which the fibrous material creates a tumor.

**Fibroma** are constituted chiefly of white fibrous tissue, variously intermingled with yellow elastic fibres, or of elements resembling the rudimentary forms of each of these: and in accordance with the degree of development presented by these elements, there is a great diversity of external characters produced, which renders it advantageous to subdivide the class into two varieties: the first, or fibro-plastic, embracing those which are analogous to rudimentary fibrous structure; the second, or fibrous proper, those in which the fibrous element is well developed.

**External Characters.**—As a class, all fibrous tumors are firm and dense to the touch, and often lobulated on the surface. They are circumscribed and movable, being independent of the surrounding structures; when of considerable size their weight draws upon the skin; hence they are often pendulous and with a circumscribed base.

**General Characteristics.**—Fibrous tumors are usually painless; of slow growth; have their seat in the neck, mammary and parotid regions, or in the back, or in the uterus. The chief inconvenience that they create is from their bulk or from pressure on surrounding parts. They are never absorbed, and can only be well removed by extirpation. A favorite locality for the fibrous tumor is the antrum Highmorianum, where it often creates marked deformity.

## SECTION I.

### OF FIBRO-PLASTIC TUMORS.

The essential character of fibro-plastic tumors, from which they derive their name, is that they are composed of structures similar to those of rudimentary fibrous tissue. This class embraces the " Fibro-cellular" tumors of Paget, and very many of those designated as sarcoma, and especially as albuminous sarcoma, by the older writers, as well as the *Fibro-plastic* tumors of Lebert, and the " Sarcomatous, or soft fibrous tumors," of Bennett.

**External Characters.**—The fibro-plastic tumors are rounded or oval in their shape, and smooth or lobular on their surface, frequently hard and unyielding, but occasionally more or less soft, and even fluctuating to the touch. In bulk they vary greatly, from the size of a pea to huge masses a foot or more in diameter. They are most frequently subcutaneous; increase slowly without pain, and possess little vascularity.

**Seat.**—The fibro-plastic tumors are found especially in the scrotum, or about the genital organs of the female, but they may occur anywhere beneath the skin, and have been observed in the deep-seated intermuscular spaces of the thigh and arm, in the orbit, in the tongue.*

The skin covering them is usually healthy, but occasionally, where the growth is rapid, they may ulcerate and slough. They are generally painless, and produce no inconvenience except from the bulk which they attain.

**The painful subcutaneous tumor** of the English surgeons, a variety of the class under consideration, is an exception to this rule. It is small, seldom larger than half an inch in diameter, and exceedingly painful, a condition supposed by some to result from pressure upon a nervous filament.

Fibro-plastic tumors occasionally enlarge with such rapidity that they may be confounded with encephaloid cancer. At other times, their growth is slow, occupying many years. As a general rule, it may be stated that they grow more rapidly than other innocent tumors.

**Diagnosis.**—The tumors with which the fibro-plastic class may be most readily confounded are fibrous tumors, and, occasionally, carcinomatous. Fibrous tumors are generally harder and grow less rapidly than fibro-plastic, but a distinction cannot always be made until after extirpation. The diagnosis from cancer will be given under the latter head.
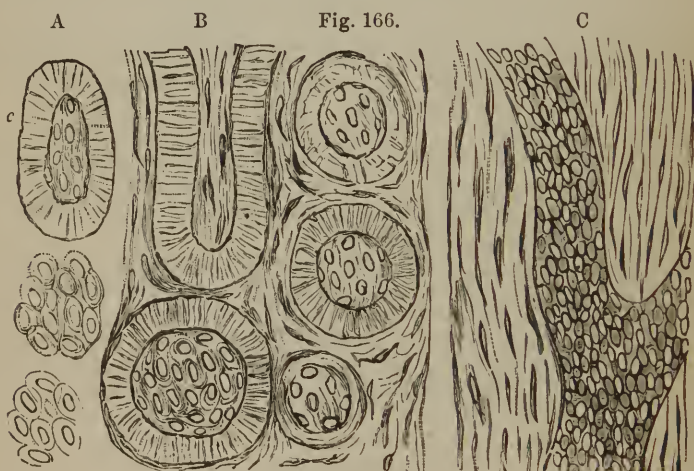


A SERIES OF DIAGRAMS REPRESENTING MICROSCOPIC SECTIONS OF A SARCOMATOUS TUMOR, AS REMOVED FROM THE FEMALE BREAST, CONSISTING MAINLY OF THE FIBROUS STRUCTURE OF THE GLAND, WITH ENLARGEMENT OF THE INCLUDED DUCTS AND THEIR EPITHELIAL LININGS.—A. Section of the epithelium from one of the tubes. *a*. Section of epithelium. *b*. Group of epithelial cells. *c*. Same after addition of acetic acid. B. Thin section of the same tumor after the addition of acetic acid. C. Another section of transverse to former, and similarly treated. (After Bennett.)

**Anatomy.**—When fibro-plastic growths are examined, after removal, they are generally found to be enveloped and separated from the surrounding tissues by a distinct cyst or sac of areolar tissue, upon which the blood-

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* Paget, Lectures.

vessels ramify prior to plunging into the interior. The substance of the tumor is but slightly vascular, and, when the tumor is lobulated, the lobules are generally separated from each other by septa derived from the external capsule.

When a section is examined by the naked eye, it appears fibrillated, yellowish, or more or less reddened by its vascularity, is succulent, and has a peculiar oily appearance, due to the infiltration of its substance with a fluid rich in albumen.

**Microscopical Characters.**—Microscopical examination exhibits an immense number of nuclei and nucleated cells, most of which are spindle shaped and elongated at the extremities. Delicate fibrils may also be observed in greater or less abundance, Fig. 166. In the main, these elements may be well described by saying that they are similar to those which are seen in organizing lymph.

**Treatment.**—The only available mode of treatment in these tumors is extirpation, according to the general rules before given. Once removed, they seldom return. Occasionally, however, they have been reproduced after the operation, and a few cases are recorded in which the disposition to the formation of such growths has been as it were generalized throughout the economy, leading to the production of numerous masses of a similar anatomy in the lungs, liver, and other internal organs, though this is rare.

## SECTION II.

### SIMPLE FIBROUS TUMORS.

**External Characters.**—These growths, which have been also called Desmoid, from the Greek δεσμος, a ligament, are very generally smooth or superficially lobed, spheroidal, or oval in shape, and freely movable, except when their seat is in the bone or the periosteum. To the touch they are hard and unyielding, often remarkably so. The skin covering them is generally healthy in its appearance, but sometimes, from the pressure produced by the size or the situation of the growth, may be adherent to the tumor and atrophied, or even ulcerated. Fibrous tumors, as a general rule, do not acquire excessive size, yet, occasionally, they attain prodigious bulk, under which circumstances they sometimes protrude through the ulcerated cutis, giving rise to troublesome hemorrhage.

The general health of the patient seldom suffers, unless from the pressure made by large tumors upon important organs, or in the cases of hemorrhage just alluded to. They are generally painless, and grow slowly.

**Seat.**—They are most frequent in the uterus; but are also found in the subcutaneous adipose layer of the neck or back, the lobules of the ear, or, indeed, any part of the body; in the mammary and parotid glands, and in connection with the bones and fibrous membranes, as in the antrum Highmorianum, about the jaws, etc. etc. The group of fibrous polypi hereafter to be described has the same structure as these tumors.

**Diagnosis.**—Fibrous tumors may be confounded with hard cancer, and with cartilaginous, osseous, and fibro-plastic tumors.

The diagnosis from cancer will be given hereafter. (See CARCINOMA.) From fibro-plastic tumors, to which these tumors stand in the closest relation, they cannot always be distinguished. Frequently, however, the slower growth and greater hardness of the fibrous tumor enables the surgeon to distinguish it from the former.

From cartilaginous or bony growths, the fibrous tumor, especially when it springs from the periosteum, cannot always be distinguished before removal. The peculiar elastic sensation communicated to the touch by many enchondromata is, however, occasionally a guide; while bony tumors are often recognized by their irregular shape and great hardness.

**Anatomy.**—Fibrous tumors have a distinct vascular capsule of dense areolar tissue, by which they are separated from surrounding parts. The tumor itself is seldom very vascular; its cut surface is grayish or grayish white in color, and the fibrous structure is generally recognizable by the naked eye.

**Microscopic examination** shows that the mass of these fibres closely resembles bundles of white fibrous tissue, more or less intimately interwoven, but yellow elastic tissue in greater or less abundance is often intermixed; and fibres resembling those of the unstriped muscles have also been observed, especially in fibrous tumors and polypi of the uterus.

**Treatment.**—The only known means of relieving the patient is by operative interference, and the tumor once thoroughly removed seldom recurs. Cases, however, are recorded in which they have reappeared in the cicatrix, and even invaded the internal organs; and it is but just to state that, in these cases, to which Paget has applied the term "malignant fibrous," there is no anatomical peculiarity by which they can be discriminated from the ordinary innocent variety.

## SECTION III.

### FATTY TUMORS, OR LIPOMA.

Tumors of adipose tissue, or **Fatty Tumors**, are so called on account of their close resemblance to the normal adipose tissue of the body. They have also very generally been known under the designation of Lipoma.

**External Characters and History.**—These tumors are of the most variable size, sometimes attaining prodigious bulk. They are generally more or less lobulated, as in Fig. 167, and are soft and doughy to the touch. Sometimes, however, they present to the fingers a peculiar and deceptive sensation, like that of fluctuation, which may occasionally mislead. The skin over them is healthy, except after they have attained great size, when the superficial veins become congested, as, indeed, is the case with all tumors under similar circumstances. Ulceration and sloughing of the cutis, and even of the tumor itself, may occur, though this is exceedingly rare.

Fig. 167.



A representation of the Lobulated Lipomatous Tumor, with its various lobuli. (After Miller.)

Fatty tumors occur most frequently in connection with the subcutaneous adipose layer of the trunk, neck, shoulders, and hips; but they may be produced in almost any part of the body, having been noted in the deep intermuscular spaces; in the liver, kidneys, lungs, etc. They generally occur singly; but two, three, or even larger numbers may be found in the same person. When situated subcutaneously, if they attain a marked size, they are apt to become pendulous, a very large mass often depending by a narrow neck, a circumstance which may be also noted in the fibrous and fibro-cellular tumors.

Fatty tumors generally grow slowly, but sometimes a tumor, which has been for years increasing very gradually, assumes suddenly an unwonted degree of energy, and grows most rapidly for awhile, sinking eventually, it may be, into its original sluggishness. In their growth these tumors are usually quite painless, producing no inconvenience, except from their bulk.

**Diagnosis.**—The ordinary tumor of adipose tissue can generally be recognized with comparative certainty. From the sebaceous cyst or wen—with which, if small, it might be confounded—it can generally be distinguished by the less distinct sense of fluctuation, and by the fact that the skin over the wen is apt to be preternaturally thin, while that over the adipose tumor is generally healthy. It is not always possible, however, to make a distinction. A large adipose tumor, undergoing the process of suppuration and sloughing, might be confounded with encephaloid cancer; but, if placed under favorable circumstances, the ulcer of the adipose growth assumes a healthy aspect, and begins to granulate, which is not the case in cancer.

**Anatomy.**—Like the fibrous tumors, those of adipose tissue are enveloped in a distinct capsule of condensed areolar tissue, prolongations from which, penetrating internally, form the septa, or divisions between the several lobules. From these septæ innumerable delicate fibrous trabeculæ proceed, which, by interlacing, form areolæ or interspaces, in which, as in the similar areolæ in normal adipose tissue, the groups of fat cells repose. The bloodvessels which nourish the tumor ramify on these fibrous divisions.

**Microscopical Examination.**—To the eye, fatty tumors resemble ordinary fat, and even the microscope shows that the fat cells themselves differ in no essential particular from those of normal human fat. Sometimes the cells are said to be larger than is normal, and occasionally the superabundance of margarine in the fluid contents of the cells leads to its deposition in groups of minute pointed crystals, Fig. 168, as the tumor cools, of margarine and cholesterin, designated by Müller as "cholesteatoma," Fig. 169; but these peculiarities are also to be noted at times in normal fat.

Fig. 168.

Fig. 169.



Fig. 168. A representation of the Structure of an Adipose Tumor removed from the back. *a.* Isolated cells, showing the crystalline nucleus of margaric acid. (After Bennett.)
Fig. 169. A view of Cholesteatoma or Fatty Tumor removed from under the tongue. It was as large as an orange. (After Liston.)
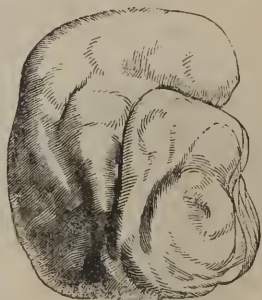
All possible varieties exist in the proportions of the fibrous to the fatty element in these tumors. Sometimes the fibrous element is so abundant, the areolæ so narrow, and the groups of adipose cells so small, that the tumor is almost fibrous in its character; sometimes the areolæ are very large, and the groups of adipose cells voluminous, the tumor being then apt to be soft or even fluctuating. Between these extremes all possible transitions exist, to many of which names have been applied, which it is not necessary to repeat.

**Treatment.**—Extirpation is the only treatment available.    Once completely removed, fatty tumors are seldom reproduced in the cicatrix, though this occasionally happens; and the same perversion of nutrition which led to the development of the tumor in the first instance may lead to the production of others elsewhere.    It has already been mentioned that a number of fatty tumors may exist in a single individual; when this is the case the tumors generally make their first appearance at different times, and it will be readily understood that local measures addressed to the removal of the first of a series, can have no effect in preventing the development of others. In the vast majority of cases, however, where a single tumor has existed for several years without the appearance of others, its complete removal is not followed by any reappearance of the disease.


# SECTION IV.

### CYSTIC TUMORS, OR CYSTOMA.

**General Characters and History.**—Under the designation of **Cystoma** are included certain closed sacs of condensed areolar tissue, containing the most diverse fluid, or mixed fluid and solid contents.    They may occur in almost any of the normal tissues of the body, though they are especially frequent in certain localities, such as the *ovary*, the *thyroid* and mammary glands, the *kidney*, the *liver*, etc.    They may also occur in the substance of pathological growths, and are frequently found imbedded in fibro-plastic, fibrous, and cartilaginous tumors, and in cancer.    Cancers containing cysts have been designated by the term Cysto-Carcinoma, and when the cysts are numerous, and contain a jelly-like matter, the cancer is called "Colloid." Innocent tumors containing cysts have been designated by the term Cysto-Sarcoma.

Much has been written concerning the origin of Cysts.    Perhaps in the present state of our knowledge it will be safe to say that there is good reason to believe that all of them have their origin in modifications of some previously-existing normal structure.    Thus the closure of the ducts of the sebaceous glands, by permitting the secretion to accumulate and distend the affected follicle, gives rise to those cysts which are popularly called wens.    So certain cysts in the mammary gland have their origin in obstructed and distended milk-ducts.    In the thyroid gland, extreme distention of the closed vesicles which characterize the gland structure of that organ, the result of various exudations into their interior, gives rise to the formation of cysts, and constitutes one of the varieties of *Goitre*.    Obstruction in the duct of the submaxillary gland frequently originates the cyst called Ranula. Obstruction in the ducts of the mucous follicles of the Schneiderian membrane gives rise to these

Fig. 170.



Example of the Cysto-Sarcomatous Tumor of the Breast—the cysts being distinctly lined by a secreting membrane, and filled with a glairy fluid. The cells are part of the original structure dilated. (After Miller.)

*mucous cysts* which constitute one variety of *Polypi of the nose;* and exudation into previously-existing bursæ gives rise to one of the varieties of *Synovial cysts.*

Those cysts which cannot be directly traced to modifications in previously-existing ducts or sacculi probably originate, as taught by Wedl, in the dis-

tention of one or more of the areolæ in the normal areolar tissue of the body, or in that of new formations accompanied by a closure of the passages through which they communicate with neighboring areolæ. This is probably the origin of these ovarian cysts which are not distended Graafian vesicles, of many mammary and other cysts, and of all those cysts which are found in the substance of cancers, and other solid tumors. In addition to these modes of origin, it is taught by Rokitansky* that new-formed nuclei of pathological origin may overgrow and distend into cysts. This doctrine is denied by Carl Wedl, who is disposed to attribute all cysts to the casual conditions above laid down. It will be readily understood that the tumors originating in cysts, or complicated by their presence, are of the most varied characters, and it would be impossible, without quite transcending the limits of this work, to give even a tolerable sketch of the appearances presented. Several of the varieties which are most important surgically will be described, in connection with the affections of certain regions, in subsequent pages, and we shall, therefore, after a few general remarks on the anatomy of cysts, mainly confine ourselves to a description of those *subcutaneous sebaceous cysts* or *wens* which come so frequently under the notice of the surgeon.

**Anatomy.**—The cyst wall or sac is always composed essentially of condensed areolar tissue, which may be either completely developed, or partially undeveloped, as indicated by the presence of numerous spindle-shaped cells with but few fibres. It is generally vascular, and is more or less firmly adherent to the surrounding textures. Frequently it is lined by an epithelium which sometimes represents a previously-existing structure, and is sometimes of new formation.

The contents are of the most varied kinds, and the cyst is generally named in accordance with the peculiarities presented in this particular; thus, we have Serous cysts, when the contents resemble more or less the liquor sanguinis; Sanguineous cysts, when hemorrhage has taken place into the cavity from the vascular wall; Synovial cysts, when the contents resemble synovia; and Colloid cysts, when the content is the peculiar jelly-like matter which will be alluded to under the head of Colloid Cancer.

Cysts presenting solid as well as fluid contents are spoken of as Proliferous cysts. The solid matter may be hair, as in certain subcutaneous sebaceous cysts, and some ovarian cysts; or teeth and bones often mingled with hair, as is especially noted in the ovary. In other cases the wall of the cyst is the seat of a growth which projects into the interior, and this may be of the most various character, composed sometimes of fibro-plastic or fibrous tissue, which may also be the seat of cysts, so that the primary cyst may contain one or many secondary cysts in its interior, justifying the appellation "Endogenous cysts." In cysts associated with cancer, the growth which projects into the cavity of the cyst is generally composed of cancer matter.

## SECTION V.

### OF SEBACEOUS CYSTS, OR WENS.

**Sebaceous Tumors** have also been called "encysted" by many writers; but this term is objectionable, since it would apply to all classes of cysts.

The sebaceous cyst is probably always formed in consequence of the obstruction of the duct of one of the sebaceous follicles; this being closed, the

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* Pathological Anat., Sydenham edit., p. 221.

secretion accumulates and distends the sac, which gradually enlarges to a very considerable degree; at the same time, a process of hypertrophy goes on in the fibrous layer of the follicle, which thus becoming quite thick and firm, constitutes the walls of the cyst.

**General Characters and History.**—Sebaceous cysts occur most frequently upon the scalp, though they are also noted on the face, the neck, or indeed on any part of the surface of the body.

They occur as smooth, rounded, or oval tumors, varying from the size of a pea to that of a goose egg, or even larger. They are soft, compressible, and sometimes present an unmistakable sense of fluctuation, though this is not invariably the case. If any considerable bulk is attained, the growth is apt to become pedunculated. The skin over them is often thin and firmly adherent to the tumor beneath; its hair follicles are atrophied, and the surface is often usually devoid of hairs, even when the cyst is seated in the scalp.

They may be met with at any period of life, but more frequently in adults than in children. The patient may present one or several, large numbers of them frequently existing in the same individual. In their growth they are generally slow, years often elapsing before they attain any great size.

**Diagnosis.**—The sebaceous cyst is, perhaps, more likely to be confounded with the adipose tumor than with any other, and, as the adipose tumor sometimes communicates to the touch a sensation easily mistaken for fluctuation, the diagnosis occasionally becomes a matter of difficulty.

The peculiar thinning of the skin over many sebaceous tumors, and the broader base of most fatty tumors of the same size, will, however, aid in forming an opinion.

**Anatomy.**—The wall of the cyst is invariably composed of condensed areolar tissue, sometimes fully developed, sometimes developing, with a preponderance of spindle-shaped cells over fibres. This fibrous outer wall is lined by an epithelium, which is the modified expression of the proper epithelium of the affected follicle and its duct.

The contents of the tumor, rich in fat and fluid, or more or less semi-solid, in consistency represent the accumulated sebaceous secretion of the follicle, more or less modified by changes, probably of a purely chemical kind, which go on in the confined secretion.

The microscope detects, amid innumerable oil drops, delicate cells with oily contents, representing the detached secreting cells generally observable in sebaceous matter; epithelial scales derived from the duct, and which are exceedingly abundant if the duct is obstructed near its peripheral termination rather than near the follicle itself; crystals of the phosphates and amorphous earthy matters, with plates of cholesterin, which are sometimes so abundant as to cause a peculiar glittering appearance, even to the naked eye.

In accordance with the proportions in which these elements are mingled together, the contents of the sebaceous cyst exhibit the most varied aspect and consistence.

The older writers applied special terms to the tumor, in order to designate the character of the contents. Thus, when the fluid contents of the cyst resembled honey, in consistency and color, the tumor was designated as *melicerous*, from the Greek μελ, honey. When the contents were thicker, and of a lighter color, it was termed "atheromatous," from αθηρα, pap, etc. These names, however, indicate no real diversity in origin or nature, and may well be permitted to pass into oblivion.

The term **pilous** tumor has been applied to sebaceous cysts containing hair, as well as to those more obscure cysts, found in the ovary and else-

where, containing not only hair, but often bones and teeth, and regarded by some writers as the remains of a dead and disorganized fœtus.

How the hair gets into this position in a sebaceous cyst can readily be understood, when it is remembered that the sebaceous glands normally open into the hair follicles. When a hair follicle becomes so involved with the enlarging sebaceous sac as to get within the cavity of the cyst which it forms, it may continue to grow, and, perhaps, with preternatural rapidity, on account of the increased vascular supply, until a considerable quantity of hairs accumulate in the cavity of the cyst.

**Treatment.**—Sebaceous tumors are best treated by extirpation, which, if properly performed, is never followed by a return of the disease, although the same causes which led to the development of the first cyst may lead to the formation of others elsewhere.

Extirpation may be performed in the same manner as for any other tumor, but it is generally considered preferable to *enucleate* it by slitting the tumor up with a bistoury, squeezing out its contents so as to permit the cyst to collapse, and then, seizing the skin on one side with one pair of forceps, and the sac on the same side with another, draw out the sac by moderate traction, or dissect it, if adherent to subjacent parts. It is exceedingly important that the whole sac should be removed, as experience has shown that if even a small portion be permitted to remain, it will continue to secrete, and the tumor will be reproduced. In the small cystoma, found in connection with the eyelid, it sometimes suffices to open the sac, evacuate its contents, and then cauterize it with the nitrate of silver, the sac subsequently sloughing out, as it possesses a low vitality.


## SECTION VI.

### GLANDULAR TUMORS, OR ADENOMA.

Under the general designation of **Adenoma** may be included all those tumors of glands which in their minute structure do not differ essentially from the glandular tissue of the affected organ. This group, called adenoma, is strictly a hypertrophy of gland texture, as the lipoma and fibroma were hypertrophies of the fatty and fibrous tissues. It therefore includes all those tumors of the mammary gland which have been named "Chronic Mammary tumors," by Sir Astley Cooper, "Imperfect Hypertrophy of the mammary gland," by Birkett and Lebert, "Mammary Glandular tumor," by Paget, and "Adenoid," by Velpeau, as well as all those cases of chronic enlargements of the Prostate gland, and of the Lymphatic glands not characterized by the presence of tubercle or cancer. The chronic disorders of the Thyroid gland, which produce the condition designated as "Bronchocele or Goitre," might also be placed under this head; but for convenience this will be described in connection with the Disorders of the Neck, in vol. ii.

Adenoma vary somewhat in appearance and course when seated in the different glands of the body; thus adenoma of the breast are commonly of oval shape, more or less lobed upon their surface, firm and elastic, and covered by healthy integuments. They are most common in young, unmarried, or barren women, who present more or less menstrual disorder. At times they grow very slowly, but in other cases with considerable rapidity. Generally mammary adenoma are small, though they attain sometimes great size, one having been removed by Liston* which weighed twelve pounds. Sometimes

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* Paget, Lecture 29.

they are quite painless, while in other cases they induce exquisite suffering, producing a degree of agony equal to that of painful cancer.

The adenomatous tumors are generally bounded by a distinct cyst or sac of areolar tissue, and present to microscopic examination lobules, quite similar to those of an inactive mammary gland, but unconnected with the excretory ducts of the breast.

A further description of these tumors will be given in connection with Diseases of the Breast, vol. ii.

**Adenoma affecting the Lymphatic Glands** are generally seen about the neck or the lower jaw, though they may occur in any part of the body, as the groin, axilla, or mesentery. They may supervene upon acute adenitis or inflammation of the lymphatic glands, or may arise gradually, as the result of irritation that induces hypertrophy; one or several adjacent glands being involved in the tumor, which is consequently more or less lobulated, and of variable size. They vary also greatly in firmness, sometimes being quite soft, at other times almost as hard as scirrhus.

The skin covering them is usually healthy, except when it becomes the seat of inflammation and suppuration, when it presents an irregular, thin, ulcerated surface. Adenoma can often be traced to the local irritation produced by neighboring ulcers, tumors, or morbid conditions of various kinds; and, according to Bennett,* the enlargement of glands in the neighborhood of cancerous or scrofulous ulcers or tumors is not necessarily evidence of the presence of cancer or tubercle in these glands, as the enlarged axillary glands often seen in cases of cancer of the breast are, in his opinion, not unfrequently only simple hypertrophy of these glands.


## SECTION VII.

### EPITHELIAL TUMORS—EPITHELIOMA.

When from any cause irritation is developed in the skin, its appendages, or in the mucous membranes, the normal action that daily casts off dead epithelial cells is increased, and may be followed by hypertrophy, or by such thickening, degeneration, and ulcerative action as will materially modify the normal condition. Tumors thus formed on the skin and mucous membrane by the accumulation of a largely increased number of epidermic and epithelial cells, united together by filaments of fibrous tissue, and furnished with blood-vessels, as the result of the organization of the fibrinous deposit, have been called, by Hannover, **Epithelioma.**

Epithelioma vary considerably in appearance. If the result of the irritation caused by pressure on the skin, they constitute **Corns** of common language, and are a true hypertrophy of the epidermis. When the epidermic cells are closely packed together by pressure, they create **Hard corns**; when the cells are more distinct and disposed to a papillary arrangement, owing to the presence of a greater amount of moisture, they form **Soft corns.**

When the epidermic cells accumulate upon a surface in consequence of the increased action that follows a local congestion or simple redness, they form the varieties of skin disease known as the **Squamæ** or **Scaly Class,** as Psoriasis. Condylomata and Venereal warts are analogous tumors, usually found on the points where the skin and mucous membranes blend, as the corona glandis of the penis, the vulva, and anus, or about the lips and nostril. Both venereal warts and condylomata are developed apparently in some in-

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* Bennett, Clinical Medicine, p. 173.

stances in consequence of a peculiar contamination, as has been described under the head of secondary syphilis. When closely examined, condylomata are found to be formed of a congeries of papillæ, sometimes flattened on the top, while others have fissures that lead down to a common stalk. When small, condylomata are mostly composed of epithelial scales, but in the larger growths there is more or less areolar tissue supplied with small blood-vessels. A vertical section exhibits a vascular loop surrounded by a basement membrane, external to which are layers of epithelial cells that vary in thickness.* Common skin **Warts**, as often seen on the hands, belong strictly to the class of epithelioma, being formed of epithelial cells not compressed, and of a papillary form. These are mainly the result of some local irritant that increases, on a circumscribed spot, the epidermic cell action. All these tumors, when inflamed, may undergo fatty degeneration, softening, and ulceration, creating ichorous and irritating discharges, and sympathetic irritation of adjacent lymphatic glands, those of the groin occasionally enlarging from irritated corns on the toes, and those of the axilla from inflamed warts on the fingers.

The greater vascularity of mucous membranes modifies the formation of epithelioma in this tissue, the induration or small scaly wart degenerating and ulcerating, and creating, through inflammatory action, more or less induration of the parts immediately adjacent.

When any irritation develops this action on a mucous membrane or where mucous tissue and skin blend, it is apt to create an ulcerated epithelioma that is difficult to heal. This variety is found on the margin of the lip, in the alæ of the nostril, in the inner canthus of the eye, after fissure of the nipple, on the tip and margin of the tongue, on the os uteri, as well as on the vulva, prepuce, and anus. The rodent skin ulcer of the scrotum, and lupus are also assigned to this same class of growths. When in these localities epithelioma is developed, it commences as a flattened induration or scale, which is followed by a slight crack or fissure, and an ichorous watery exudation that is irritating. Hence increased action, then ulceration, with induration of the margin, so as to give an apparent depth to the ulcer, which is, in reality, quite superficial. The pus from this ulcer being small in quantity, soon dries, and forms a scab or scale, which, being accidentally removed, is followed by slight bleeding and another crust, the reproduction being in this manner continued for months. When these ulcers are examined microscopically they present on the surface masses of epithelial cells in all stages of development. The lymphatic glands near these ulcers often enlarge, and are secondarily affected, in consequence of which many writers regard this variety of epithelioma as analogous to cancer. That epithelioma may assume the cancerous peculiarities under some circumstances, is beyond question; but it is equally certain that it is erroneous to regard all epithelioma as cancerous, some of the cases being only evidence of disordered epidermic and epithelial cell action, and capable of perfect cure.

The opinions of pathologists, on the identity of epithelioma and cancer, are, however, yet much divided, Paget, Velpeau, and Schuh regarding it as cancer, and calling it epithelial cancer, while Lebert, Hannover, Bennett, and Lawrence deny its cancerous nature.† Lawrence thus arranges the arguments :—

### I. For Epithelioma being Cancer.

1. Its infiltrating character.
2. Its tendency to infect the lymphatic glands.

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* Bennett's Lectures.                    † Lawrence on Cancer, 1858.

3. Its tendency to recur after removal.
4. Its fatality.

## II. Epithelioma is not Cancer.

1. From the excessively rare occurrence of consecutive deposits.
2. Its anatomical structure.
3. The absence of primary cachexia.
4. Its frequently local origin.

A careful study of the question, seconded by some experience, induces me to regard the question as thus correctly stated :—

1st. Epithelioma exists as a distinct growth, characterized by epithelial cells, as in corns, thickened skin, horns, warts, etc.

2d. These may become the seat of cancerous action, and run the course of cancer to degeneration, though in the least marked form, being then well designated as "cancroid."

3d. There is a cancer of the skin and mucous membranes, originating in the follicles, that presents the usual elements of cancerous action elsewhere, which yet presents epithelial cells, and the other normal elements of the tissue invaded.

4th. Simple epithelioma is to be regarded as really a hypertrophy which, when inflamed or irritated, ulcerates and undergoes the usual changes of healthy inflammation.

When, as is sometimes seen, a sebaceous follicle participates in the increased epidermic cell action of epithelioma, it results in a thickened growth that is so indurated as to be called a **Horn.** Some of the instances of this development, and especially one well known to visitors in Paris, on the forehead of a woman, have attained several inches in length.

**Anatomy of Epithelioma.**—The cut surface of an epithelioma is generally grayish white in color, and the texture is solid or semi-solid, quite friable, and does not generally yield anything resembling the "cancer juice." Microscopic examination shows infiltrated, among the textures of the part affected, great numbers of cells of irregular shape, $\frac{1}{200}$ to $\frac{1}{1200}$ of an inch in their long diameter, which more or less closely resemble normal epithelial scales; whence the name of the disease. Besides these free nuclei, the peculiar bodies, the "globes épidermiques" of Lebert, and the "laminated capsules" of Paget, can be observed, as well as spindle-shaped cells, which are often found in considerable number, according to Wedl, who asserts that the idea that epithelioma exhibits no forms which cannot be referred to the epithelial type, is based on the most imperfect research.

**Diagnosis.**—A clinical diagnosis can generally be made before the removal of the tumor, if the age of the patient and the papillary character of the growth, as well as its locality, be regarded. Occasionally ulcerated scirrhus of the skin and mucous membranes, and perhaps lupus, may be confounded with epithelioma. Both these errors will, however, at once be rectified after the removal of the growth and a study of its minute anatomy, with the assistance of the microscope.

**Treatment.**—Epithelioma demands varied plans of treatment, in accordance with the nature and locality of the growth. Hard corns and the scaly varieties are often cured readily by protecting the part from pressure, or by softening ointments and plasters. Condylomata and venereal warts may be destroyed by chromic or nitric acid or powerful astringents. The same treatment is applicable to warts on the hands or generative organs, not the result of syphilis, being in the latter case consequent on inattention to cleanliness or the presence of acrid discharges. The ulcerated variety will gener-

ally require such treatment as is applicable to cancer of the skin, under which head it will be stated. Epithelioma of the canthus of the eye, alæ of nose, and the superficial variety seen on the lip, os uteri, etc. is best treated by the repeated application of the dry, powdered sulphate of zinc, as proposed by Simpson, of Edinburgh, the application being repeated until a healthy surface is produced, and then dressed as a healthy ulcer. In the simpler forms seen in the os uteri I have obtained much success from this treatment. The addition of powdered gum-arabic will dilute the application when desired, and also favor its adhesion to the surface.

## SECTION VIII.

### VASCULAR TUMORS, OR ANGIONOMA.

Under the designation of **Vascular Growths** or **Tumors** reference will here be made only to such as are composed almost entirely of blood-vessels, reserving aneurisms, varicose veins, etc. to other heads.

These growths, though well designated by Bennett as angionoma, have been described under different names, those seated in the skin being spoken of as **Nævi Materni**, or mother's-mark, the popular ideas having long incorrectly connected them with the mental impressions of the mother during pregnancy. Another variety of vascular tumors, chiefly formed by enlarged capillaries united by free areolar tissue, have been called "Aneurism by anastomosis." The term "Telangiectasis," which has also been bestowed upon them, is objectionable from its length; while that of "Vascular Tumors," though correctly indicating their nature, is inappropriate, because other tumors are more or less vascular. Besides these terms, others have been bestowed upon certain varieties of tumors formed in a similar manner.

**General Characters and History.**—Nævi do not always come under the designation of tumors. Sometimes they are situated in the skin alone, and produce no visible thickening of it. They are then of various size, from mere spots to patches several inches in extent, and of various colors, being always some shade of red when the chief lesion is the size and number of the blood-vessels, but sometimes brownish and dark colored, from the deposit of pigment in the intervascular tissue. From such discolorations there are various transitions to disk-like, oval, or even spheroidal, pulsatile tumors, involving the subcutaneous tissues, and which may be of any size, from that of a pea to that of an orange, or even larger. Such growths may make their first appearance at any time of life, but most generally they exist at birth, or make their appearance shortly after. They often enlarge with great rapidity, and, if allowed to take their course, may rupture or ulcerate, and terminate life by the consequent hemorrhage. Growths similar in anatomy to the above occasionally occur in internal organs.

**Anatomy.**—Angionoma consist entirely of tortuous and convoluted blood-vessels, held together by the remains of the skin and subcutaneous tissues of the part in which they occur. Generally they are supplied by one or two large blood-vessels, and have but moderate vascular connection with the surrounding parts.

**Diagnosis.**—The color and general appearance of these growths, and the fact that by steady pressure they may be partially emptied of blood, which returns when the pressure is removed, generally suffice for a diagnosis. They have, however, in past time been occasionally confounded with other vascular growths, and especially with that vascular form of medullary cancer formerly called Fungus Hæmatodes, a mistake that originated in the idea,

now generally abandoned, that nævi were prone to become the seat of can-
cer.    In most instances, the impossibility of emptying the vessels of the
cancerous growth to any extent, by pressure, will aid the diagnosis.

Prognosis.—Unless of considerable size and long standing, the prognosis
of the cure of angionoma is favorable.    When large and pulsatile, the
operation may be attended by free hemorrhage, and in some cases be fol-
lowed by erysipelas.

Treatment.—Various modes of treatment have been proposed.    Of these,
perhaps the ligature has had the most numerous advocates, either as applied
by needles transfixing the tumor, or by encircling it; but this is not as expe-
ditious as the knife, and presents no advantages over extirpation if properly
performed.    The usual objection urged to the latter plan of treatment is
the danger of hemorrhage; but if the incisions be made in the sound tissues,
carefully avoiding a wound of the growth itself, little or no hemorrhage
occurs, except from the one or two large nutritive vessels before alluded to,
and these are easily controlled by ligature after the removal of the tumor.
The wound thus left should be closed by suture, and often heals promptly.
Another mode of treating these tumors is by developing such an inflammatory
action as will cause them to slough, as will be stated in the account of Oper-
ations on the Head, vol. ii.


## SECTION IX.

### CARTILAGINOUS TUMORS, OR ENCHONDROMA.

Under the designation **Enchondroma**, a group of tumors was described
by J. Müller, the essential character of which is a resemblance, in their mi-
nute anatomy, to cartilage.    The English term, **Cartilaginous Tumors**,
employed as a substitute by Paget, appears preferable, but either designa-
tion sufficiently indicates the structure of the new formation.    By the older
surgeons they were called **Osteo-Sarcoma,** and frequently mistaken for can-
cer; and when they soften, they certainly resemble it, though the difference
may be told by the action of acetic acid.

General Characters and History.—Although most frequently met with
in connection with the bones, enchondromata have been found in the soft
tissues, as in the parotid gland, the testicle, the breast, and even in internal
organs.    They are spherical, or nearly so, in shape, smooth or lobular on the
surface, and often peculiarly elastic, giving the idea of fluid contents, though
at other times they may be hard and incompressible.    There is no uniform
rule as to the rapidity of their growth, which is in some cases very great, and
in others quite the reverse.    The size they may attain is often considera-
ble; and, in certain cases, in which a vast bulk is attained in a short time,
sometimes only a few months, the constitutional symptoms and local appear-
ances closely resemble those of medullary cancer, the chief difference, in
addition to that shown by microscopic examination of the cell wall and
nucleus, after the addition of acetic acid, being that extirpation generally
effects a cure in the case of the enchondromata.

Enchondroma, though generally single, may occur in considerable num-
bers in the same individual, as in cases in which a number of the phalanges
of the hands are involved, each being the seat of a separate growth, or in
the rarer instances in which, in connection with an external tumor, a number
of nodules exists in internal organs.

Cartilaginous tumors frequently ossify, sometimes completely, but gener-
ally, however, only partially; the latter being the true osteo-sarcoma of the
older writers.

**Anatomy.**—Enchondroma are invested by a distinct capsule of condensed areolar tissue. When the tumor is lobulated each separate cartilaginous mass is at once separated from those adjoining, and connected with them by laminæ of the same structure as the capsule. On these laminæ and on the capsules the larger blood-vessels of the growth ramify. When a section is made, the cartilaginous nodules are more or less translucent, and grayish white or pinkish white in color. The degree of consistence is very variable, being from a semi-fluid viscid mass to a hardness approaching, but generally not attaining, that of normal cartilage.

Occasionally in a tolerably firm growth a central softening may be noticed; and the same occurs in individual nodules, giving rise to the appearance of cysts filled with a tenacious liquid and imbedded in the cartilaginous growth.

**Microscopical Characters.**—The minute anatomy of these growths is not less variable than their appearances to the naked eye. It may, however, be indicated with considerable correctness by stating that it approximates more or less closely to that of healthy cartilage, and, as all the analogies of other new formations would lead us to expect, rather to the undeveloped cartilage of the fœtus than to that of the adult. The matrix in which the cartilage cells are imbedded may be pellucid or slightly granular, but most generally it is more or less fibrous in aspect, causing the whole growth to be comparable rather to the fibro-cartilages than to the hyaline or true cartilages, Fig. 171.

The cells themselves, large, ovoid, or somewhat polygonal, from mutual pressure, are often quite comparable with those of ordinary embryonic cartilage. The nuclei of these cells may be similar to those of embryonic cartilage, oval, with distinct outlines, and one or two nuclei; or they may be quite irregular, branched, and present the most fantastic shapes, Fig. 172.
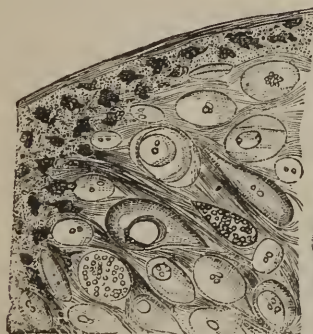
Fig. 171.　　　　　Fig. 172.



Fig. 171. A microscopic view of a thin section of an Enchondroma from the Pelvis. (After Bennett.)
Fig. 172. A microscopic view of the Corpuscles from the softened part of the same Tumor. (After Bennett.)

These appearances may be modified by the softening of the tumor, by its calcareous degeneration, or by its ossification, the latter process being similar to that by which normal cartilages are transformed into bone.

**Diagnosis.**—Enchondroma may be confounded with cysts,* from which it is not always possible to distinguish it by external examination. The use of a grooved needle, or of a small-sized trocar and canula, would, however, be available in discriminating between the two. Rapidly developing tumors are often looked upon as encephaloid cancer, and it is sometimes

* Paget, p. 422.

impossible to determine the nature of the growth until after its removal from the body.

Remarks have already been made on the diagnosis of enchondroma from fibrous tumors.

**Prognosis.**—The prognosis should be guarded, as there is in some cases a repetition of the growth in other organs, death ensuing in a manner similar to cancer.

**Treatment.**—Extirpation is the only plan of treatment which promises success; but the results of operations are not so uniformly successful as in the case of adipose growths. Although in the larger number of instances persons from whom these tumors are removed remain cured, yet cases not unfrequently occur in which they return to their primitive seat, even after complete extirpation; and in some few recorded instances post-mortem investigation has shown in the internal organs, as the liver, etc., numerous cartilaginous nodules, similar in structure to the primary growth. Besides these exceptional cases, in which cartilaginous growths pursue a history similar to that of cancer, cases occasionally occur in which they are associated with cancer, a part of a tumor being cartilaginous and a part having the anatomy of cancer. Such growths run the usual course of cancer, and benefit by the application of the same treatment as is hereafter recommended for cancer.

## SECTION X.

### OSSEOUS GROWTHS, OR OSTEOMA.

**Osteoma,** or **Bony Tumors,** will be considered with the Disease of the Bones.

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## CHAPTER III.

### CANCER, OR CARCINOMA.

UNDER the head of Cancer, or Carcinoma, general usage has placed all growths variously denominated **Scirrhus, Medullary Sarcoma, Fungus Hæmatodes,** etc., in which the meshes of a fibrous stroma, or the normal connective tissue of any portion of the body, are infiltrated by nucleated cells. When the fibrous element is in excess, and the tumor evidently firm and hard, it is called **Scirrhus,** or **Hard Cancer;** if the cells are numerous, and the tumor elastic or soft to the touch, it is termed **Encephaloid,** or **Soft Cancer;** if the fibres form areolæ or cavities, and these are filled with a glue-like matter, it is known as **Colloid Cancer,** or the **Carcinoma Reticulare** of Müller. All these tumors have a marked tendency to degeneration and death, and have also a disposition to reappear in or near their original seat, and to run a fatal course, notwithstanding the efforts of the surgeon to remove them; hence they have been designated as Malignant growths, their malignancy being marked in proportion to the softness of the substance composing their structure, Soft Cancer, for example, being more frequently noted as recurring after removal than Hard Cancer. Ulceration, which, in benignant tumors, is an accidental accompaniment of their growth, forms

part of the usual history of carcinomatous tumors, commencing in their substance, and often extending to the skin, before the latter is distended in a marked degree by the development of the tumor.  These tumors also are usually, but not invariably, the seat of acute pain, and are liable, in some instances, to be attended by a defective general nutrition, that has been described as the Cancerous cachexia.  Being thus possessed of marked peculiarities, surgeons supposed they were justified in distinguishing them from those which do not degenerate, and which have been already alluded to as Benignant growths or tumors of a less destructive character.  Pathologists have, however, recently denied the propriety of this distinction, Bennett, of Edinburgh, especially objecting, because "every morbid growth is liable to recur in spite of all the resources of art."  Velpeau* has also reported twenty-six cases of *proved* carcinoma, both scirrhus and encephaloid, which were successfully removed without the disorder returning.  Some of these had the disease so advanced that large masses of the neighboring glands were involved, and yet the patients lived from five to nine years after the removal by an operation, without any return of the affection.  Hence, as Bennett has remarked,† "we may just as correctly talk of a rheumatism being innocent or malignant, as apply these terms to fibrous, cartilaginous, or osseous, or other morbid growths, for no other reason than because they are sometimes localized on a part, and at others are more general."

**Pathology of Carcinoma.**—Carcinoma may manifest itself as a growth or tumor in almost any of the tissues of the body, enlarging with a degree of rapidity that generally exceeds that belonging to any other growth.  The tumor may be single, or several may originate simultaneously, the consistence being hard and strong, as in scirrhus, or soft and pulpy, as in encephaloid, while between these extremes there may be every possible transition.  As a general rule, the softer the tumor the greater the size it attains, and the more rapid its course to destruction.

As the tumor enlarges, it encroaches upon and invades adjacent tissues, while similar growths occur in the neighboring lymphatic glands, or in distant organs of the body, and the disease thus multiplies itself throughout the system; though every lymphatic enlargement attendant on the cancerous tumor must not necessarily be cancerous, it being, as before stated, in some instances, simple adenoma.

**General Appearance of a Cancerous Tumor.**—Carcinomatous tumors, as a class, present "sometimes well defined, easily movable, spherical, irregularly knobbed, lobulated, branched tumors, which lose their circumscribed character during their development by insinuating themselves between the elements of textures previously merely displaced.  Or they may from the first be infiltrated masses, involving the textures, without definite limits."‡

Their size varies greatly, some, especially the soft variety, as encephaloid and colloid, attaining considerable magnitude, others appearing as millet-seed tubercles or granules, as seen in the skin and serous membranes.

Scirrhus, or hard cancerous tumors, attain less size than the soft variety, are much harder, more flattened and disposed to retract and pucker up the adjacent structures.  When encephaloid appears in a gland, as the mamma, it will occasionally give rise to a bloody, ichorous discharge from the nipple through the milk ducts, which is not seen in the hard tumors.  The special diagnostic signs will, however, be again alluded to.  When ulcerated, the ulcer almost invariably presents the characteristics hereafter given in connection with each variety.

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* Maladies du Sein, 1858.                    † Clin. Med., Philada. edit., p. 207.
‡ Rokitansky, Pathol. Anat., vol. i.

**Progress of the Tumor.**—The course of a cancerous tumor has been well divided, especially by Gerdy, Laennec, and Broca, into five periods: 1st. That of the origin or first appearance of the growth. 2d. The benignant period, when it is in its crude or imperfect development. 3d. Its maturation and degeneration, (the softening and ulceration of Laennec.) 4th. The extension of the disordered action to other parts. 5th. The cachectic period. Each may be advantageously studied in detail.

1st. THE ORIGIN.—The earliest appearance of a cancerous tumor depends greatly on the patient's powers of observation. Sometimes it is felt when very small, while at others it has attained the size of a walnut or egg before it is noticed, and is then thought by the patient to have been mysteriously developed. When the tumor is of the hard variety of cancer its growth is slow, but in the soft cancer it is more rapid. The early tumor is not painful unless it is so situated as to encroach on a nerve.

2d. THE BENIGNANT PERIOD.—The crude condition of the tumor during its early stages has been regarded by some as evidence that the tumor was at first benignant, and became malignant, an error now generally admitted. At this time the tumor may have a moderate bulk, but is indolent and without marked local symptoms, unless of a size that presses or draws upon the surrounding parts. Thus in the eye it now sometimes impairs vision or develops evidence of cerebral disturbance; in the antrum, tongue, lips, breast, or bladder, it may create functional disturbance, but not more so than would ensue on the presence of any mechanical cause. The duration of this period varies greatly, sometimes extending to fifty years, as in the case of a female cited by Gerdy,* and may in many cases be judiciously improved by an appropriate local and general treatment, as hereafter mentioned.

3d. THE PERIOD OF MATURATION.—At this time the cancerous tumor begins to develop local nervous and vascular disturbance, of a more or less violent character. Sometimes the pain is transient, and of a pricking, shooting character, while at others it is most acute, burning, gnawing, and pressing, the sensibility being increased by handling, pressure, motion, or similar causes. Sometimes pressure is not painful at the moment, yet is followed by acute suffering, as is often seen after the examination of the tumor by various surgeons. At this time the evidence of local vascular disturbance becomes marked, the tumor increases in size, and sometimes becomes hot and heavy, while an increased flow of blood with congestion is apparent on the skin, which soon takes on the symptoms of inflammation with a surrounding œdema, this being followed by ulceration and sloughing, which may eventually throw off a portion of the tumor, and leave an indolent or irritable ulcer, as hereafter described; or the disorder may progress so as to give evidence of the presence of the next period.

4th. THE PERIOD OF EXTENSION, as described by Broca, is characterized by the appearance of new growths in adjacent or distant organs, as in the adjacent lymphatic glands, or in the liver, lungs, bones, etc. This period is more marked in cases of soft than of hard cancers, the new tumors being often found to contain the elements seen in those first developed. How this extension of the disease is accomplished has long been a disputed point. Whether the blood can take up and carry to distant parts any element capable of being deposited, or whether it is the result of such modified cell action in the part first affected as creates a change in the adjacent cell action, and so on to distant parts, must continue to be a theoretical question, not easily to be adjudicated, until that of normal nutrition is well elucidated and proved.

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* Monograph on Cancer.

5th. THE CACHECTIC PERIOD. — At periods which vary, in accordance with the duration of the preceding periods, there is often seen, in those suffering from cancer, an anemic condition of the blood, with general defective nutrition, that has been long designated as the cachectic period, or more generally as the "Cancerous cachexia." In this period, which is characteristic of the generally impaired powers of life, the suffering is often most intense, creating marked insomnia, loss of strength, a yellow, livid, or leaden hue of the skin, with extreme emaciation, and all the symptoms of hectic fever, as seen in connection with other disorders. The night-sweats, diarrhœa, hemorrhage, ichorous discharge, etc. produce in these cases of cancer very much the same general symptoms as are seen from wounds and other serious injuries and long-continued discharges. The prominent symptoms of this period have doubtless had their influence upon the opinions of the large number of pathologists who regard cancer as a blood disease. But daily observation presents to every surgeon instances of well-marked cancerous tumors in those who are ruddy, fleshy, and apparently in good health; hence we must look upon the so-called "Cancerous cachexia" as the effect, and not the cause of cancerous tumors, as will be again referred to in connection with its etiology.

Etiology.—A large number of pathologists at one period regarded cancer as consisting essentially in a special blood disease, which they named the "Cancerous Diathesis," or "Cancerous Dyscrasis," the tumors seen being viewed only as the local manifestation of this condition, though the precise nature of the anomaly in the circulating fluid was merely a matter of speculation.

At another time Langenbeck, Andral, and others thought they had detected a peculiar cell in the blood; and blood has been drawn, by an enthusiastic young microscopist, from the finger of a patient, with a developing cancer of the mamma, in the expectation of exhibiting the so-called "cancer cell." Sometimes the blood was found by Andral to be less coagulable, the proportion of its globules being diminished, yet this cannot be said to be peculiar to cancer; while the sallow skin, emaciation, etc. are not unfrequently seen in phthisis pulmonalis. The fragility of the bones was likewise at one time assigned to cancer, yet such a condition is often seen under such circumstances from impaired nutrition, and yet offers no evidence of cancer. We have not then at present any well-established and positive evidence that the cancerous tumor is the result of a general dysæmia, and although this opinion is contrary to the theories of some of the ablest pathologists of the day, and accords with the ancient ideas of the humoralists, we yet regard this point as unsettled.

Another question connected with the etiology of cancer, arising out of the preceding one, is that of hereditary influence, which, until a very recent period, was almost universally admitted. Within a short time, however, this opinion has been denied by high authority. Thus Lawrence,[*] adding to 102 cases observed by M. Lebert[†] 49 observed by himself, states that of the 151 cases he has obtained, and in which this point had been particularly inquired into, there were only 21 patients in whom the history appeared to justify the idea of hereditary transmission, or about one-seventh of the total number of cases, or fourteen per cent. He therefore concludes that this proportion is too small to establish such a fact, and that cancer ought not to be regarded as a hereditary disease, at least in the usually received sense. More recently S. W. Sibley, Lecturer on Pathological Anatomy at the Middlesex Hospital, in a paper on the statistics of cancer, read before the Royal Medical and

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* Diagnosis of Surgical Cancer. † Traité des Maladies Cancéreuses.

Chirurgical Society of London, states that of 305 cases on the records of
the hospital in which this point had been particularly inquired into, 34
patients remembered to have had a relation affected with cancer.   If we re-
gard these 34 cases as instances of hereditary transmission, we shall have,
adding Sibley's cases to those enumerated by Lawrence, 456 cases of cancer,
in only 55 of which—about twelve per cent.—the influence of hereditary
taint was noted.

Contagiousness of Cancer.—The question of the *contagiousness* of can-
cer, which was also a disputed point formerly, is now generally regarded as
decided in the negative.

Another point for discussion was the possible effect of Local Injuries in
creating or developing cancerous tumors.   Although there are some who,
like Velpeau, assert that local injury may lead to the development of cancer,
yet the general belief among pathologists is that a local injury will only
determine the seat of the growth.   How it does so is not known.   According
to Virchow's more recent views, the local injury modifies the cell action by
modifying its vital irritability, and hence the transformation of normal nutri-
tion and the development of an abnormal tissue.   Bennett, on the other
hand, advocates strongly the opinion that "certain growths abounding in
cells have a great disposition to infiltrate themselves among the neighboring
parts," and hence thinks one of their chief modes of propagation is by the
adjacent cells, in the process of development, becoming infiltrated among the
neighboring tissues.   Vanderkolk also inclines to a similar opinion, "sug-
gesting that the fluids which they contain mingle with the juice of the paren-
chymatous substance around them," and thus transform them into similar
structures.   If cancer can be thus developed locally, the influence of the
presence of the tumor upon the adjacent parts should have considerable
weight in deciding us as to the best means of arresting the disorder, so
that it may be thoroughly eradicated.

But, though unable to decide *how* cancer is created, there are some con-
ditions which are generally admitted to precede and accompany its thorough
development.   Among these the effect of depressing mental emotions has
long been recognized as important, these acting, probably, by impairing the
digestive function, and thus modifying the nutrition, especially of the abdomi-
nal organs—as in cancers of the pylorus of the liver, uterus, etc.; while the
sympathetic connection of the mammæ with the uterus, and the special in-
fluence of the mind over the menstrual flow, seems to offer some reason for
admitting the power of this cause.   Yet Paget states that in 91 cases 66 were
either robust or in good health, 9 uncertain, and only 16 sickly or feeble.

That blows, falls, and injuries of various kinds, by causing inflammatory
action and a modified local nutrition, can prove a local cause of cancer, also
seems probable, and must certainly be admitted as appearing to be promi-
nent examples of the effects of such injuries in some cases, though a large
number have been collected by Lebert, Paget, and others where no local
cause could be assigned.   Thus Paget states* "that, out of 91 patients, less
than one-sixth ascribed hard cancer to any local cause; while of 79 tumors
not cancerous, 15, that is, 1 in 5¼, were ascribed to injury or previous dis-
ease."†   He would, therefore, be disposed to deny the influence of injury
altogether, were there not a few cases which favored a different opinion.

General History of Cancerous Growths.—Although the etiology of can-
cer is thus imperfect, yet the researches of pathologists have collected many
interesting facts in regard to the general history of these new formations,
which may now be advantageously alluded to.

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        * Page 514, Phila. edit.                    † Page 515, op. citat.

**Sex.**—It has been conclusively shown that the majority of the victims of cancer are of the female sex, the statistics of Sibley, before referred to, exhibiting the fact that, of 519 cases of cancer in the Middlesex Hospital, 103 were in males and 416 in females. According to Lawrence,* of 4778 cases of deaths from cancer, reported as occurring in London between the years 1845–50, 1118 were in males and 3660 in females. According to either of these statements, then, between three and four cancers occur in females to every case occurring in a male, and, with every possible allowance for statistical error, we can only conclude that the female is much more liable to cancer than the male.

**Seat.**—With regard to the *seat of the disease* almost any vascular organ may be involved, though the female breast and the uterus are the most common situations. Thus, of Sibley's 519 cases, 191 were of the female breast and 156 of the uterus. The comparative frequency of cancer of other organs will be discussed in connection with the several varieties of the disease.

**Age.**—Cancer may occur at *any age;* it is, however, far more frequent after middle life than in the young. Perhaps the most common period for its appearance is between forty and fifty years of age, as in the following table of Paget.† Of 772 cases of all kinds of cancer, there were:—

| | |
|---|---|
| Under 10 years of age | 27 |
| Between 10 and 20 years of age | 30 |
| Between 20 and 30 years of age | 78 |
| Between 30 and 40 years of age | 130 |
| Between 40 and 50 years of age | 200 |
| Between 50 and 60 years of age | 152 |
| Between 60 and 70 years of age | 98 |
| Between 70 and 80 years of age | 57 |
| | —— |
| | 772 |

**Previous Health.**—In the majority of cases there is nothing in the previous health of the patient which would lead us to anticipate the disease. As a general rule, the victims of cancer have been usually quite healthy, and in some instances remarkably so. Lawrence found that 22 out of 30 cases of scirrhous and encephaloid disease had enjoyed unimpeachable health.‡ Under this head the fact of the extreme rarity of cancer in tuberculous patients may be mentioned.

The peculiar constitutional condition frequently noted in the latter stages of cancer has been alluded to as the **Cancerous Cachexia.** The fact that such a condition may occur is undoubted—especially is it noted in cancers of huge size, in those that have ulcerated, and in those which interfere with the functions of important internal organs. As before stated, this condition is characterized by anemia, often of the most marked degree; by emaciation, which is frequently extreme; by disturbance of the digestive organs, a peculiar yellowish or waxy hue of the skin, an anxious expression of countenance, exhausting sweats, etc. Whether this cachectic condition is peculiar to cancer, and the necessary ultimate result of the blood disease; or whether, as some contend, it is in every case traceable to some obvious cause, as exhausting discharges from an ulcerating surface, interference with the functions of important internal organs, etc., its diagnostic value is much impaired by the fact that, in many cancers terminating fatally, no peculiar or special constitutional symptoms are at any time observed; while in some the patient preserves his usual *embonpoint* up to the very moment of the fatal termination.

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* Loc. cit., p. 49.      † Surg. Path., p. 642.      ‡ Diagnosis of Cancer, p. 56.

**Anatomy of Cancerous Growths.**—Cancerous tumors, as a general rule, are not separated from the surrounding tissues by a distinct capsule of areolar tissue, as is the case with most benignant tumors.   On the contrary, they invade irregularly the surrounding parts, among the anatomical elements of which the cancerous material is infiltrated in such a manner that the normal textures can often be recognized imbedded in the substance of the morbid mass.   The tissues thus involved generally undergo atrophy, degenerate, and finally disappear, their place being occupied by the cancer itself; hence this has been called "Cancerous substitution."  When a section of a cancerous growth is made, it presents the most varied appearance to the eye; generally it is of a grayish or yellowish white, which may extend throughout the tumor, or be seen only in patches, or it may even present a yellow, greenish, bloody, brown, or black color—all these several shades, except the grayish or yellowish white, being the result of accidental circumstances. Thus the yellow color is the result of exquisite fatty degeneration; the bloody or reddish-brown patches are due to hemorrhage, (capillary rupture;) while hemorrhagic patches, altered by time, become greenish, brown, and black, coloration being due to pigment (melanotic) deposit.   The consistence of the section, and the resistance it offers to the knife, varies from stony hardness to a brain-like softness.

**Microscopical Characters.**—Careful microscopic investigation by many observers, among whom Johannes Müller, Vogel, Lebert, Paget, Bennett, Rokitansky, Virchow, and Carl Wedl are prominent, has revealed the following minute structure: The cancerous tissue is formed of an areolar framework or "*Stroma*," as it has been named, which in most cancers is composed of fibrous tissue.   The bands of this stroma are interlaced with each other, and are so arranged as to include between them numerous interspaces or areolæ, which communicate freely with each other.   These areola are filled with a fluid or semi-solid pulpy matter, the "*Cancerous parenchyma*," "*Cancer pulp*," or "*Cancer juice*," which is composed of a more or less plentiful albuminous fluid, in which innumerable *granules, nuclei,* and *cells,* Fig. 173, can be observed.

Fig. 173.



A microscopic view of the Cells of Hard Cancer, showing their varied shape, with the numerous free Nuclei, as seen in Scirrhus of the Breast.  Magnified 500 diameters.  (After Paget.)

**Of the Stroma of Cancers.**—The stroma of cancers, as a general rule, is made of white fibrous tissue, with which a few yellow elastic fibres are intermingled.   It may, however, especially in uterine cancers, present fibres similar to those of the smooth muscles; and occasionally it is ossified, as in the cancers connected with bone.

The white fibrous element may consist of well-developed bundles, quite indistinguishable from those of normal white fibrous tissue; or the fibrillæ may be preternaturally coarse.   In soft cancers of rapid growth the stroma consists merely of caudate cells, similar to those of lymph or fibro-plastic growths, and is probably an undeveloped form of fibrous tissue.

The stroma presents various conditions as to its quantity and arrangement in different cancers.   In hard cancer the areolæ are quite small, and

the quantity of the fibrous stroma, as compared with the areolar part of the cancer, is great; while in soft cancer the stroma exists in small quantity, and is often in an undeveloped state, the areolæ being filled with the cancer pulp and comparatively large. Sometimes the areolæ are transformed into cysts, as in colloid cancer.

**Of the "Cancer Pulp or Juice."**—The formless fluid in which the granules, free nuclei, and cells, of the cancer pulp are immersed is a rich albuminous liquid, described by many writers as the Cancer Blastema. It is impossible to obtain this fluid pure in any quantity under ordinary circumstances, and its precise composition is therefore a matter of dispute, some affirming that it is a peculiar and special fluid, while others insist that it presents no demonstrable peculiarities by which it can be—outwardly at least—distinguished from the normal nutritive production or the so-called blastema of other growths. When this liquid exudes, after scraping the tumor, as a creamy juice, which owes its color and opacity to the granules and nuclei cells that float in it, it is called the "Cancer Juice." The *granules* which float in it are innumerable, and generally of minute size; very many of them at least are extremely small oil drops $\frac{1}{20000}$ to $\frac{1}{10000}$ of an inch in diameter, coated with a thin film of albumen, though others perhaps are molecules of nitrogenized matter, and some even of an inorganic nature. Besides these granules, oil drops of larger size, coated with albumen, are constantly encountered in the examination of cancer.

The FREE NUCLEI are of various shapes—spherical, oval, oblong, elongated, or irregular in outline, and generally of great size, averaging $\frac{1}{2500}$ of an inch in diameter. They are usually clear or dimly granular, and contain one, two, or sometimes several large, distinct nucleoli.

The CELLS vary even more in size and shape than the nuclei. They are round or oval; some are polygonal, from mutual pressure; some furnished with one or more processes, and many so irregular in shape as to baffle description. Generally they are more or less granular, and often include several large oil drops. These cells are almost always nucleated, the nuclei being quite like the free nuclei just described. Cells are frequently observed containing two, three, or even several such nuclei. In diameter these cells vary from $\frac{1}{1600}$ to $\frac{1}{700}$ of an inch. Perhaps the majority of them lie within even narrower limits, $\frac{1}{1200}$ to $\frac{1}{1000}$ of an inch. (*Paget.*)

Almost all the modern observers agree essentially in the description above given. Yet the widest difference will be found in the interpretation of these observations.

These different opinions may be, to a great extent, included under two opposite and contradictory doctrines.

One group of pathologists teaches that the nuclei and cells of cancer are quite unlike those of any normal texture or any benignant growth, and hence describe them as *heterologous* elements, and name them "Cancer nuclei" and "Cancer cells." It is true that they generally admit the impossibility of a microscopical diagnosis from the appearance of a single cell, but they insist that the examination of a group of cells is quite sufficient to justify a positive conclusion. Especial importance is attached by them, in forming an opinion, to the great and variable size, the diversity in shape, and the granular appearance of the cells, the great proportionate size of the nuclei and nucleoli, and the existence of several nuclei in many of the cells, and of several nucleoli in many nuclei. Prominent among the supporters of this doctrine are Paget, Robin, and Lebert.

On the other hand, many pathologists, among whom may be mentioned J. Müller, Virchow, and Carl Wedl, affirm that the heterologous character of the elements of cancer are merely simulative, asserting that between

the most characteristic "cancer cell" and the elements of some innocent tumors, and of certain normal, especially embryonic structures, every possible transition exists; and that the most peculiar forms can be interpreted by taking into consideration the changes effected by those processes of hypertrophy and atrophy to which all cells, normal and pathological, are liable.

Space does not permit a full discussion of these disputed points, for the full elucidation of which the reader is referred to the pathological treatises mentioned in the note at the foot of this page.*

According to Virchow's views, as taught in his Cellular Pathology, the cancer cells and nuclei result from the excessive multiplication by division of the cells of the affected tissue, and cancer is therefore not strictly a *new formation*, but a pathological metamorphosis or transformation of the organ in which it is seated.

FATTY DEGENERATION makes its appearance at an early period in the life of cancers. Indeed, so early as the cancer itself can be recognized an unusual quantity of fat is generally observed in the form of numerous oil globules, both in the fluid between the cells and in the cells themselves. At a later period the degeneration becomes more marked; parts of the interior of the cancer structure may be liquefied into a fluid which resembles pus to the naked eye, and ulcers make their appearance upon the periphery of the growth.

The ulceration may or may not be accompanied by inflammatory symptoms, but in either case we may be sure that the minute processes in the ulceration of cancer are similar to those of ulceration elsewhere. Sometimes granulations, often abundant and luxuriant in their growth, sprout from the bottom of the ulcer, especially in soft cancers. In structure such fungous growths present the anatomy of cancer.

The discharge from the cancerous ulcer is most variable in its appearance to the eye and in its minute conditions; sometimes it is a thin, bloody liquid, in which the microscope detects the debris of the cancer structure; at other times it is in appearance, both to the eye and the microscope, quite similar to ordinary pus.

**Of the Varieties of Cancer.** — The classification of cancer which appears most natural describes FIVE varieties, to wit: 1. **Hard Cancer, or Scirrhus. 2. Encephaloid, Soft, or Medullary Cancer. 3. Melanotic Cancer. 4. Colloid Cancer. 5. Epithelial Cancer.**

1. The term Scirrhus, or Hard Cancer, is applied to the tumor in which the fibrous stroma predominates over the cellular element.

2. When the reverse is the case, the cancer is called Soft, or Medullary, or, from its resemblance to the substance of the brain, Encephaloid.

3. Any cancer colored brown or black, from abundant pigment deposit, will fall within the group of Melanotic Cancer, and is generally seen in *soft* cancers, of which, therefore, Melanotic Cancer may be considered a variety.

4. A cancer containing cysts filled with a glue-like or "colloid" substance is designated Colloid Cancer.

5. An Epithelial Cancer is one found in connection with the skin or mucous membranes, the cells of which present a striking resemblance to ordinary epithelial cells.

As the symptoms, diagnosis, and prognosis of each of these vary somewhat, their details will be separately studied hereafter.

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* Paget's Surgical Pathology; Bennett's Cancer and Cancroid Growths; Lebert's Pathological Physiology; Virchow's Archiv; Carl Wedl's Pathological Histology; Lawrence on Cancer; Virchow's Cellular Pathology.

The duration of a cancerous tumor varies greatly, sometimes continuing many years before causing death—four being about the average—while in more acute cases, rapidly inflamed by injudicious treatment by "cancer curers," death supervenes much more rapidly.    The duration of the disorder depends, undoubtedly, upon the employment of such means as will prevent the growth, development, and degeneration of the earliest-formed portion of the tumor, and the inflammatory action that would favor sloughing.

## SECTION I.

### GENERAL THERAPEUTICS OF CANCER.

The treatment applicable, as a general rule, to all varieties of cancer, should be based on the following indications :—

1st. To diminish or check the local vascular action.

2d. To inspire hope as far as is consistent with truth ; improve the digestion, the blood, and the eliminating organs of the economy.

3d. To remove thoroughly such tumors as have not contracted deep adhesions, including in the removal a circumscribing portion of sound tissue.

### § 1.—Local Remedies.

1. In diminishing the local circulation or accomplishing the first indication the means must be varied in accordance with the locality of the tumor.    When external, it should be covered with an unirritating and anodyne plaster, as the emplast. saponis and belladonna, so as to protect it from external irritants; allay the nervous sensibility, and keep up a constant exhalation from the skin.    If the local congestion is marked, blood may be abstracted by leeches, applied around or on the circumference of the tumor, or in the course of its blood-vessels—as the front and inferior edge of the axilla, for the mammary gland; in the groin or on the cord, for the testicle and penis ; under the jaw, for the tongue and lip, etc.

Where there is a disposition to unnatural heat, cold mucilage cloths, or the cold water-dressing, or cold washes frequently applied, with the addition of astringents, will often prove highly serviceable.    In all instances of developing tissue, cold and the abstraction of blood tends to arrest, while heat and moisture favors growth.    Arnott, of London, whose frigorific mixture has been already described as a local anæsthetic, also advocates its employment for the relief of pain and retarding of the growth of cancerous tumors of the surface of the body.    In a case treated in the Middlesex Hospital, London, the patient, who had a deeply ulcerated and extremely painful scirrhous tumor, was so much relieved by the application of the frigorific mixture as to request its repetition.    Simpson, of Edinburgh, has also derived benefit from this application in cancer of the uterus.    It is therefore probable that this powerful remedy will ultimately be proved to be a valuable addition to our means of treating cancer.    In some cases, as in the breast, a judiciously arranged *compression* will prove serviceable, especially that obtained by the application of a piece of compressed sponge and a well-applied series of strips of adhesive plaster; or even, as noted in some cases, by regularly, firmly, but not painfully, compressing the gland by adhesive strips, applied obliquely around the breast until it is covered. Recamier, in 1823, employed a conical compress of *agaric*, with its base directed on the tumor, holding it in place by the spiral bandage of the

breast, (p. 120,) and, when the tumor was lobulated, applied one compress
over each prominence, and gradually compressed them.    Patent lint would,
of course, do as well; the benefit derivable from the treatment depending
on the skill of the surgeon in bandaging the tumor equally and firmly, yet
not so as to irritate it.    Even in a badly ulcerated scirrhous breast treated
in the Blockley Hospital, Philadelphia, much satisfaction was derived from
covering the ulcer thickly with the levigated carbonate of iron, then apply-
ing a graduated compress of layers of patent lint, and then applying, with
great care and accuracy, the bandage of the breast before alluded to.
When the cancerous ulcer suppurates freely, this dressing should be changed
every twenty-four hours, but in a few days the discharge will diminish, and the
dressing need not be reapplied so frequently.    The good effect obtainable
from pressure soon shows itself, and can be highly recommended; but it must
be so graduated as to diminish the vascular supply to the tumor, favor the
serous infiltration of tissue, and check cell action, if it is expected to induce
atrophy.    If violence is permitted, or such a degree of pressure as creates
irritation, that is, if the dressing is uncomfortable two hours after its appli-
cation, it will be liable to develop inflammation, and do harm by hastening
the destructive process.

It is, however, well known that surgeons at various periods have esti-
mated very differently the value of compression in the treatment of cancerous
tumors, many, of extended experience, regarding it not only as useless,
but as absolutely injurious, on the ground that if it removes the local dis-
order it must be by driving it into the circulation.    The slight value of such
an objection is apparent.    That pressure causes atrophy by checking the
supply of blood, is established beyond a doubt; that it has been serviceable
in many cases, is also unquestionable.    How it does harm, is only explainable
by the creation of irritation and inflammation, both of which are evidence of
the improper application of the remedy.

2.  To inspire hope and improve the mental condition by such statements
of the retarding of the disorder as are consistent with our certain knowledge
of the destructive tendency of cancer, is to aid digestion, equalize the circu-
lation, and thus counteract an important source of depression.    When well-
established cases have lived fifteen, twenty, thirty, and fifty years, the patient
may justly hear the suggestion that her case may be similar.    The utility of
administering chalybeates is self-evident, when we recall the tendency of can-
cerous tumors to appropriate to themselves nourishment that eventually
drains the powers of life and establishes hectic fever.    But unless combined
with such local means as have been stated under the first indication, these
articles will not prove so very beneficial.    The administration of the bitter
tonics and of mild anodynes are decidedly useful, and especially the extracts of
gentian and hyoscyamus, which have long enjoyed professional confidence.  To
eliminate from the blood all noxious or irritating matter is highly conducive
to health under all circumstances, and especially so in a disorder like carci-
noma.    Too much attention cannot, therefore, be paid to the condition of the
skin, tepid baths or sponging every twenty-four or forty-eight hours being
strictly attended to, while at the same time the action of the bowels and
kidneys should be carefully watched.    The saline laxatives, as cremor tartar,
or the natural waters of our springs, as those of Saratoga, Bedford, Sharon,
or Virginia, will thus prove highly useful, and may be generally obtained in
most large towns, when the patient cannot visit the springs.    Sea bathing I
have known to be useful on general principles, it being mainly valuable by
improving the state of the skin, while the salt atmosphere and exercise
improve the general powers of the system.

3. When the preceding means have been judiciously employed, the neces-

sity for such measures as fulfill the third indication will be much delayed, especially if the surgeon is consulted before injury has been done by quackery.

The manner of removing the tumor may be either by the knife or caustic, as will be hereafter stated in connection with the special seats of the growth. There are, however, some general observations that may be appropriately presented here.

**Caustics.**—Caustics, the varieties of which will be stated in connection with skin cancer, are specially applicable when the tumor is circumscribed, superficial, small, uninflamed, and near no important organ, as the eye, etc. To large tumors these articles are not generally thought to be applicable, as they increase the surrounding vascular action, render the sloughing of a mass highly offensive, develop suffering that is greater than that of the knife when a patient is etherized, and leave a large ulcer that is often tedious and painful, while tending to cicatrization. Such is the general surgical opinion, though Simpson, of Edinburgh, thinks otherwise. Except in epithelioma, or very circumscribed tumors, as in true cancer of the lip or labial glands, or penis, or cervix uteri, caustics are, I think, not as useful as the knife as a means of local treatment. The failure to cure, and the dreadful sufferings induced by the caustic treatment of the notorious Fell, in London, as compared with extirpation, are too well known to require comment.

**Extirpation.**—The general extirpation of cancerous tumors is to be accomplished in accordance with the rules laid down for other tumors, (p. 35.) The cases specially fitted for an operation are the hard, unequal, lobed, slowly-increasing tumors, especially of scirrhus, when there is little or no inflammation in the part. While any cancerous tumor is inflamed and rapidly increasing, it will prove useless and often injurious to attempt its extirpation. When the tendency to extension is slow but sure, when the previous local and general treatment has failed, and when the mass, if left to undergo the sloughing and ulcerative process, would render the patient loathsome to self and friends, and deprive her of many of the attentions that friendship delights to offer, I deem an operation proper. Even in cases of well-marked encephaloid of the mammary gland, with a considerable degree of fatty deposit, I advise an operation on these grounds, though stating the fact of the probable return of the disorder. The rapid healing of the wound after the operation gives prompt though temporary relief from suffering, and inspires hope, and an improved digestion by permitting exercise. If the disease reappears in the cicatrix, there is less tissue to slough, and if it reappears in the lungs and liver, the last scenes are easier and less distressing to the patient and friends than when attended by a sloughing ulcer. The prognosis of the result of the operation will be again alluded to in vol. ii. in connection with the operative proceedings. Among the marked counter-indications to any operation I place such tumors as are so situated as to involve large vessels, as the carotid and external iliac in cancers of the parotid or the glands of the groin, or on the deep glands of the axilla. The superficial axillary glands may be removed, and sometimes prove to be adenoma, though consequent on scirrhus of the breast. Then old patients, who are likely to be exhausted by the suppuration attendant on the operation, should not be touched; while a marked cachexia or anemia, and loss of red blood, with cases of numerous tumors, and especially those which from their size have been designated as "shot-like," and indicate general infiltration, should be deemed sufficient to exempt the patient from all operative interference.

### § 2.—General Remedies.

The general remedies applicable to cancerous tumors consist in the free administration of tonics, to improve the appetite and favor the digestion of nutritious food; of chalybeates, to augment the richness of the blood by increasing its red corpuscles; and of anodynes, to allay pain and promote sleep. These indications may be accomplished by employing bitter extracts, quinine, iron, conium, or hyoscyamus, the selection of the article being decided by circumstances and the judgment of the practitioner.

## SECTION II.

### HARD CANCER, OR SCIRRHUS.

**General Characters.**—Scirrhus manifests itself as a hardened mass of variable size, from that of a pea or chestnut to that of a potato. Occasionally greater dimensions are attained, but it never acquires the bulk seen in many instances of soft cancer.

**Symptoms.**—To the touch scirrhus is firm, hard, and resisting, and evidently heavy. At first quite movable, the scirrhous tumor gradually becomes adherent to the surrounding parts, to the subjacent textures, and eventually to the skin, which is thus often puckered around the adherent point. As the tumor increases in size, more or less congestion of the superficial veins is apt to be seen, as a consequence of the pressure upon adjacent vessels. A similar distention of the veins of the skin may also, as is well known, occur over any tumor, though it is apt to be more marked in cancerous tumors.

The progress of the disorder is generally slow, occupying months or years. Yet though far slower than that of soft cancer, it is more rapid, perhaps, than in the majority of innocent growths. As a general rule, the scirrhous tumor is the seat of severe pain, which is often the first symptom that directs the attention of the patient to the disorder. In exceptional cases, however, pain may be absent even after ulceration has commenced.

The *pain* is often dull and heavy; but as the disease approaches the skin it changes its character, and becomes more burning, or like that of ordinary inflammation. When the adjacent lymphatics become involved, the pain takes on a shooting or lancinating character, and generally extends toward the nearest lymphatic glands. Thus in cancer of the breast it shoots toward the axilla; in cancer of the testicle it extends toward the groin; and, in cancer of the lip, toward the lymphatic glands of the neck. It is probable that this extension of the pain along the course of the lymphatics is due to the fact that these nearly coincide with the course of the nerves of the part, and perhaps it would be more correct to say that the pain extends in the direction of the nerves.

At a period which varies in different cases, and which depends less on the size of the cancer than on the degree in which it involves the skin, *ulceration* takes place, and the cancer is then designated by some writers as "open cancer," or "ulcerated carcinoma." The ulcer itself has been described as the "cancerous ulcer." The *cancerous ulcer* presents, in different cases and at different times in the history of the same case, the most diverse appearances. Sometimes its edges are inverted and irregular, the surrounding skin being puckered; sometimes, on the other hand, they are everted or elevated, and covered with abundant granulations.

The *discharge* from the ulcer may be thin and sanious or purulent, and exhibit under the microscope no recognizable elements; or degenerated cancer elements may float in it; while sometimes irregular or even well-formed pus cells are sometimes seen. The ulcer may enlarge rapidly, but more frequently quite slowly. From time to time sloughs are apt to form and be cast off, and then the odor is often horribly offensive.

Even in the most rapidly-ulcerating cases, however, the ulcer does not generally destroy the whole growth, which increases on its periphery yet more rapidly than it is destroyed by the ulcerative act.

After ulceration has commenced, though sometimes previously, the constitutional symptoms above described under the designation of the cancerous cachexia make their appearance, and ultimately the patient perishes from exhaustion and constant nervous irritation, or in consequence of the extension of the disease to important internal organs.

The *time* occupied by the disease from its appearance to the fatal issue varies in different cases. According to Paget, the average duration of life in 66 cases of scirrhous cancer of the breast, "from the patient's first observation of the disease, is a little more than 4 years," (49 months.)

As the external characters of the scirrhous tumor have been already alluded to, we may next study its structure.

**Anatomy.**—When a scirrhous tumor is removed from the body and examined with the naked eye, a number of characteristic phenomena are presented. Thus the tumor is hard and stone-like to the touch, of great weight in comparison with its bulk, and, when cut through, creaks or "cries" under the knife like a raw potato; the cut surface, which often, but not invariably, becomes concave or cup-like, has a grayish-white or bluish, somewhat translucent aspect, which is sometimes intersected by fibres or bands interlacing in various directions. The tumor, which seldom is invested by a distinct capsule or sheath of areolar tissue, is irregular in its shape, and frequently sends prolongations of indefinite forms into the surrounding tissues. These prolongations are popularly designated the "Roots" of the Cancer.
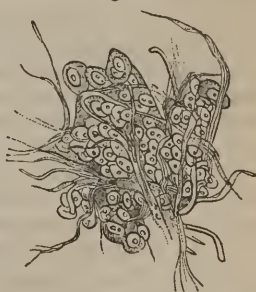
**Microscopical Characters.**—With regard to the microscopical characters of scirrhus little need be added in this place to what has been said in connection with the minute anatomy of cancerous growths in general.

The **Stroma** is dense, abundant, and closely meshed, marking out very small areolæ. It is generally composed of well-developed white fibrous, mingled with some distinct yellow elastic tissue. In the breast at least, and probably in some other situations, it no doubt represents the normal fibrous tissue of the organ in a hypertrophied condition.

Fig. 174.



The areolæ marked out by the stroma are packed full of granules, nuclei, and nucleated cells, Fig. 174, the characters of which have been fully described.

**Diagnosis.**—The diagnosis of scirrhus is often exceedingly easy, the history and symptoms rendering the nature of the disease evident even to a superficial observer; but in other cases it is difficult, and in some instances quite impossible, to come to a correct conclusion, except by patiently observing the fatal progress of the disorder. The diagnosis may be conveniently treated

A microscopic view of the Cancer cells filling the interstices among the bundles of the fibro-cellular tissue in the skin of the breast. Magnified about 200 times. (After Paget.)

of under two heads—as the **Clinical Diagnosis,** or that which is made by the surgeon from the careful examination of the tumor while still growing, and

from a thorough investigation of the history of the case; and the **Anatomical Diagnosis**, or that based upon a careful examination of the tumor after its removal from the body, both with the unaided eye and with the microscope. These several modes of examination should be conjoined, in order to attain the greatest accuracy in any instance.

The growths with which scirrhus is most apt to be confounded are the fibrous, fibro-plastic, and cartilaginous tumors, and the harder varieties of soft cancer. From the latter, however, it is not important to make a distinction, as the only difference is one of degree. The distinction from the fibrous, fibro-plastic, and cartilaginous tumors, however, is of consequence on account of its bearing on the prognosis.

**Clinical Diagnosis.**—While the scirrhous tumor is small, and before it has contracted adhesions to the skin and the surrounding parts, it presents no external symptoms which would render an accurate diagnosis possible. Its cancerous nature will, however, sometimes be suspected on account of its seat, taken in connection with the age of the patient, as, for example, if it be in the breast of a woman thirty-five years old or upwards; or the painfulness of the growth may induce suspicion. But the diagnosis thus made must always be a provisional one, and the subsequent history of the case will frequently show it to be incorrect. After the tumor has contracted adhesions, after the skin has become puckered, and especially after ulceration has occurred, the diagnosis becomes more easy, as benignant tumors do not usually contract adhesions or ulcerate till they have attained a size much greater than scirrhus ever reaches. But the surgeon will often be at fault, and uncertain of the exact nature of the complaint, until he can obtain the assistance offered by a study of the anatomy of the growth after its removal from the body.

**Anatomical Diagnosis.**—The appearance of the cut surface of a scirrhous tumor to the naked eye will not always enable the surgeon to recognize it; still it is generally less succulent with transparent liquid than the fibroplastic growth; less visibly fibrous than fibrous, and less lobulated than cartilaginous tumors. Moreover, when scraped, a creamy juice can often, not always, be obtained, which is quite characteristic, if taken in connection with the other appearances. Especially may stress be laid upon the irregular shape of the scirrhous tumor and the absence of a distinct areolar capsule; but even these characteristics, though frequently, are not invariably, present.

If on careful examination the growth be found, in connection with the external characters resembling those of scirrhus, to possess also the minute anatomy above described, the diagnosis becomes as nearly perfect as our finite senses can make any observation. With the microscope, in skillful hands, the diagnosis between scirrhus and fibrous or cartilaginous tumors becomes easy and satisfactory. So also does it between a well-marked fibro-plastic tumor and a decided scirrhus. But many cases occur in which the secondary arrangements and elementary forms of fibro-plastic growths so approximate those of scirrhus that a microscopical diagnosis is difficult, and sometimes impossible, as is shown by the failures of even so skillful an observer as Lebert.

**Constitutional Symptoms of Scirrhus.**—A consideration of the constitutional symptoms of a patient laboring under scirrhus seldom throws much light on the nature of the disease except in its advanced stages. Very often patients retain their general health until after the progress of the tumor and the character of the ulceration have rendered its cancerous nature almost certain. Indeed, although the evidences of well-marked cachectic symptoms may gravely increase the fears of the surgeon, especially as to the speedy

termination of life, their absence should not prevent an unfavorable prognosis if justified by other symptoms.

**Prognosis.**—The prognosis of scirrhus is uniformly unfavorable, although, in some cases, life is prolonged for years, until the patient perishes of a different disease; yet, as a general rule, the affection terminates fatally, notwithstanding judicious treatment.

But although no treatment as yet employed will avert the fatal issue, experience justifies the statement that well-selected local and constitutional treatment may prolong the life of the patient and greatly lessen the sufferings of this painful disorder.

**Treatment.**—The general treatment applicable to scirrhus has been before given, and that applicable to its special developments will be reserved for future consideration under each locality, after investigating the characteristics of soft cancer.

## SECTION III.

### SOFT CANCER, OR MEDULLARY CARCINOMA.

To this variety of carcinoma the terms **Medullary Cancer** and **Encephaloid Cancer** have been applied, while the stage in which degeneration has progressed, and ulceration of the skin is established with fungous granulations and hemorrhage, has been called *Fungus Hæmatodes*. The latter is therefore to be regarded as only a stage in soft cancer, and not as a variety of carcinoma.

**Symptoms.**—The tumor of soft cancer, commencing as a small lump just perceptible to the touch, grows rapidly, sometimes attaining ultimately the

Fig. 175.



A representation of the bleeding fungous stage of Medullary Carcinoma of the Breast, or the form often designated as Fungus Hæmatodes. (After Miller.)

most marked bulk. As a class, encephaloid tumors are smooth, or somewhat lobed, spherical, or oval, and vary in consistence, as indicated by the touch,

from firm and elastic, to soft and fluctuating; and so marked is the latter sensation that they have been mistaken for abscesses, and the reverse. The progress of the tumor to degeneration is far more rapid than in scirrhus; its size before ulceration occurs is also generally greater; while, as it enlarges, the vessels of the skin become congested to a greater degree than in hard cancer, the skin itself becomes thinner and thinner over the prominent parts of the growth, till it suddenly gives way, cracks, and ulcerates—the ulceration in some cases being followed by prompt sloughing of the morbid mass, accompanied by frequent hemorrhages. The latter quickly exhaust the patient; while a fungous growth, highly vascular and bleeding on the slightest touch, sprouts through the skin and soon attains considerable size, though generally constricted at the base by the orifice through which it protruded, Fig. 175. Sometimes sloughing and hemorrhage occur in this fungus, which is then quickly destroyed; while in other cases it grows yet more rapidly than it sloughs, until death by hectic fever terminates the case.

While thus growing outwardly, the encephaloid tumor encroaches also upon the surrounding and subjacent parts, destroying or modifying them as it progresses. Similar growths also appear in the neighboring lymphatic glands, in the liver, lungs, and other internal organs, as in the case of hard cancer, and these enlarging with a rapidity similar to that of the primary growth, terminate life, by interfering with important functions, even before the progress of the external disease would have proved fatal.

After an encephaloid tumor has acquired some bulk, it is often the seat of great pain; but this, as a general rule, is not so severe as in scirrhus.

**Duration.**—The average duration of life in encephaloid disease, according to Paget, is a little over two years. In many cases, however, the whole progress of the disorder, from its first appearance to the death of the patient, occupies but a few months; while in others, especially of the firmer and less rapidly-growing variety, life is prolonged for several years, the longevity being equal to that of many cases of scirrhus.

**Anatomy of Soft Cancer.**—Soft cancers are more frequently invested with a distinct capsule of areolar tissue than hard. In this respect they resemble benignant growths; but even when the capsule is most complete, the cancer substance will often be noticed, at one or more points, infiltrated through the capsule and invading surrounding textures. In other cases no capsule exists, and the morbid mass is irregularly infiltrated among the involved tissues.

A section displays the most varied consistence and color in different cases; thus it may be firm and hard, approaching the softer forms of scirrhus; or soft, diffluent, and semi-fluid; and between these extremes there is often every possible transition. In very many cases the consistence and appearance of the tumor is not unlike calves' brain—hence the name Encephaloid. In color the cancerous matter is generally grayish or pinkish white; but in spots it may be stained crimson, from hemorrhage into its texture; brownish, from pigment deposit; yellowish, from extreme fatty degeneration, etc. The texture may appear homogeneous, or may be divided into lobules by the coarser divisions of its stroma. Sometimes cysts are seen imbedded in its structure, and these may be filled with softened cancer matter, with serum, colloid matter, or blood. On scraping the surface an abundant creamy juice ("cancer juice") exudes; but this character, though more frequently present than in scirrhus, is not invariably noted. With regard to the minute anatomy of the growth, the following remarks may be made:—

The **Stroma** is less abundant than that of scirrhus, and, including much larger areolæ in its loose meshes, is sometimes composed of well-developed

fibrous and elastic tissue, but more frequently in part or wholly of caudate cells.   In certain cases even this imperfectly-developed stroma is very sparingly distributed.

The **Cells** and **Nuclei** are generally quite like those described in connection with the anatomy of cancerous growths in general, though certain special conditions may occur.   For example, the cells may be mostly wanting, and the growth composed entirely of free nuclei, Figs. 176, 177, 178, as has
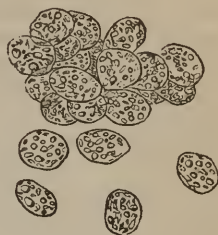
Fig. 176.                      Fig. 177.                      Fig. 178.

Fig. 176. A microscopic view of the Nuclei of Soft Medullary Carcinoma imbedded in a molecular basis substance or stroma without cancer cells.  Magnified 500 diameters.  (After Paget.)

Fig. 177. A representation of various fully-developed Cells and Nuclei of Medullary Carcinoma, as seen under the microscope.  Magnified 500 diameters.  Some of them are larger than the average, others more peculiarly slender, elongated, strip-like, or caudate cells, with darkly dotted granular nuclei.  (After Paget.)

Fig. 178. A representation of the dotted Nuclei of Medullary Carcinoma of the Breast.  Magnified 500 diameters. (After Paget.)

been described in several instances by Paget, and as occurred in three different tumors extirpated by me at the surgical clinic of the University of Pennsylvania.*   Moreover, as noted by Paget, a preponderance of caudate and spindle-shaped forms, over rounded or polygonal cells, Figs. 179, 180, 181, is sometimes observed.

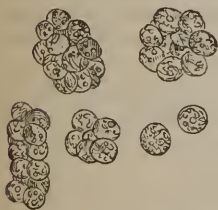Fig. 179.                      Fig. 180.                      Fig. 181.
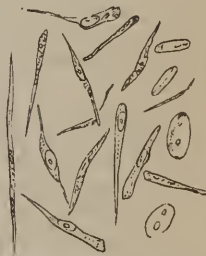
Fig. 179. A representation of the clustered Nuclei of Medullary Cancer, composed almost exclusively of round, shaded nuclei, with three or four shining particles, arranged in groups or clusters of five to twenty or more.  Magnified about 400 diameters.  (After Paget.)

Fig. 180. A representation of the Caudate and variously elongated Cells of a firm Medullary Cancer.  Magnified 450 diameters.  (After Paget.)

Fig. 181. Small elongated Cells and Nuclei with a Nucleus of the ordinary shape, from a firm Medullary Cancer.  Magnified 500 diameters.  (After Paget.)

**Diagnosis.**—The harder varieties of encephaloid cancer may be confounded with scirrhus, an error of no practical importance, as remarked in connection with the diagnosis of scirrhus.   Soft cancer may also be confounded with abscess and with the larger and  more rapidly-growing cartilaginous and fibro-plastic tumors.

The diagnosis from abscess is the more difficult on account of the distinct

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* See Am. Jour. Med. Sci., July and October, 1858.

sense of fluctuation which the softer varieties of medullary cancers often present, and on account of their rapid growth, which may equal that of the formation of an abscess. Lawrence* mentions that Roux, Sir Astley Cooper, and Liston have all mistaken abscesses for medullary cancers; and Velpeau says he "does not know how many times he has seen soft encephaloid taken for an abscess;" and that he himself has "seen a breast amputated for a supposed tumor, which turned out after the operation to be only a small chronic abscess." Similar cases are known to most surgeons. In one under my observation, an inmate of a public institution fell in the yard and injured her leg near the middle of the calf; a swelling rapidly followed, which presented a sense of fluctuation so perfect that a very able surgeon, presuming that the blow had resulted in suppuration, plunged a bistoury into it, for the purpose of evacuating the pus. No pus was, however, found, but from the wound thus made a fungus sprouted in a day or two, and soon revealed the true character of the disease. A cast of the limb is now in my cabinet.

The use of a minute trocar and canula will generally prevent such an error as this, and should always be resorted to in doubtful cases, at least prior to attempting the extirpation of the suspected tumor; but not at other times, as it tends to create irritation and increased local action.

The diagnosis of encephaloid from huge, ulcerated, cartilaginous, and fibro-cellular tumors is in many cases difficult, if not impossible. As these growths, however, seldom have a fungus sprouting from their ulcerated surface, the presence of such a growth would exclude them in the majority of cases. After the tumor is removed from the body, microscopic examination will also readily discriminate the cartilaginous from the cancerous tumor, as before shown. But all parts of the tumor should be examined, since, as was remarked under the head of Cartilaginous Growths, a part of a tumor may be cartilaginous and a part cancerous, as happened in a tumor of the testis, described by Paget. From fibro-plastic growths of huge size the diagnosis is not so satisfactory, for, though the typical forms of each can be generally discriminated, less marked instances of both classes often resemble each other closely, a circumstance which must be taken into consideration in estimating the character of those tumors of the fibro-plastic group, which have been described by authors as returning in the cicatrix and involving internal organs.

**Prognosis.**—In regard to the prognosis of medullary carcinoma and its progress toward a fatal result, it may be said that, as a general rule, it progresses much more rapidly than scirrhus, and that its return, after removal by an operation, is also much more certain and speedy.

**Treatment.**—As the general indications for the treatment of carcinomatous disorders have been already given, very little now remains to be said, except to caution the young surgeon against the occurrence of hemorrhage when the tumor ulcerates. When this supervenes, caustic and the hot iron will rather add to the mischief than alleviate it, and pressure, with such means as will facilitate the formation of a clot, only can be relied on. A mass of cobweb, a piece of agaric, or of patent lint or charpie wet with the muriated tincture, or the persulphate of iron, may be fastened on with a bandage, and so applied as to make pressure, this being the most successful mode of checking it.

If the diseased mass is to be removed by an operation, it should be done only in the early stages of the complaint. The result of such operations is, however, much more unfavorable, that is to say, the disorder reappears much more quickly than after the operation of extirpation in scirrhus. Yet, when

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* Diagnosis of Surgical Cancer, p. 70, 2d edit.

extirpation has been performed early, it has been found to be comparatively useful, for the reason already given when speaking of the operation for scirrhus, to wit: that it removes a mass which, in sloughing, becomes so offensive as to drive off friends, and render the patient loathsome even to herself.

The progress of the disorder and the benefits from an operation may be well seen in the comparative results given by Paget and Lebert, in cases that have and cases that have not been operated upon.

From these writers it appears that the average duration of life in medullary carcinoma, in patients which were not operated on, was about two years from its first being noticed, which is about one-half the average duration of life in cases of hard cancer; very few of these lasting as long as four years in even the mild forms of this cancer. But Paget* thinks that in some of these, life was prolonged by an operation, as the average duration in some of those operated on was twenty-eight months, being four months longer than that which was obtained by general treatment without the operation. The duration of life was as follows: In 51 cases operated upon by Lebert—including 9 of extirpated cancer of the eye—1 returned within six months after the operation; 13, between six and twelve months; 7, between twelve and eighteen months; 8, between eighteen and twenty-four months; 11, between twenty-four and thirty-six months; 3, between thirty-six and forty-eight months; and 8 above forty-eight months.

But these results are perhaps slightly more successful than usual, as in several of the cases the deposit was situated in the most favorable parts. Thus, in the list just given, there were nine cases of fungus of the eye, an organ in which the disease does not progress as rapidly to a fatal result as in some other parts.

**Prognosis of the Operation.**—The prognosis of the probable period of the return of the disease varies somewhat in connection with the part operated on. Thus, a patient will live longer after the operation of castration for medullary carcinoma, than after the removal of it from any other part of the body. The eye gives the next greatest longevity; then the bones, and last of all the soft parts, of which those of the extremities present the least possible chance of success, as, after amputation of the thigh for this disorder, the patient not unfrequently dies in a few weeks, with general medullary infiltration through the lungs and other viscera.

## SECTION IV.

### MELANOSIS, OR BLACK CANCER.

**General Characters and History.**—The variety of cancer to which the term Melanotic is applied is, as a general rule, simply a soft cancer, in the cells and intercellular liquid of which an abundant formation of minute pigment granules has taken place. The history of the local growth and of the constitutional disturbance in Melanotic Cancer therefore closely resembles that of the ordinary forms of soft cancer. The tumor, in size, texture, etc., is quite like the other soft cancers, and the chief external point of diversity is in color. This color differs much both in intensity and distribution. In intensity it may vary from a light brown to a deep black, and it may be uniformly distributed throughout the morbid mass, or may form irregular patches, variously scattered through cancer substance of the ordi-

* Paget's Lectures, Philad. edit., p. 561.

nary appearance.    It is probable that, in the human subject at least, the vast majority of tumors presenting on section the black or brownish color above indicated are true examples of medullary cancer.    But Paget has described an epithelioma which, from excessive pigment deposit, presented similar characteristics, and, in the lower animals at least, melanotic tumors of a non-cancerous nature are occasionally observed.

According to Paget the most frequent seats of melanosis are the skin, the tissues connected with it, and the eye.

**Anatomy of Melanotic Cancer.**—To the anatomy of medullary cancer it is only necessary to add here that the color of these tumors is due to the presence of vast numbers of pigment granules of exceedingly minute size, ($\frac{1}{10000}$ of an inch or less in diameter,) which are observed with the microscope floating free in the intercellular liquid, or inclosed within the cell walls of cells like those of soft cancer, Fig. 182.    With a high magnifying power these granules appear to have pellucid centres, with comparatively thick, black borders.

Fig. 182.



A representation of the Cells of a Melanotic Tumor of the Cheek, which are more or less loaded with black pigment. (After Bennett.)

**Diagnosis.**—The evident color of the melanotic tumor renders its diagnosis easy in the majority of cases.

**Prognosis.**—The prognosis will, of course, be that of soft cancer, of which this is but a variety.

**Treatment.**—The treatment is that applicable to simple encephaloid tumors.

## SECTION V.

### COLLOID CANCER.

**General Characters and History.**—The term Colloid is applied to tumors composed of great numbers of cysts, containing a peculiar jelly-like matter, and held together by areolar tissue.    Such tumors generally occur in internal organs, where their presence is either not suspected till after death, or where they give rise to symptoms which are brought to the notice of the physician rather than the surgeon.    Nevertheless they occasionally manifest themselves in such situations as to demand surgical treatment, and hence must receive some notice in this place.

Much dispute has arisen as to whether colloid growths should or should not be regarded as cancerous.    In the present state of our knowledge it is perhaps safest to say that while these growths are, in many instances, undoubtedly cancerous, in a more limited number of cases they pursue a history like that of innocent growths.

**Anatomy of Colloid Cancer.**—When a section is made through a colloid tumor the naked eye at once recognizes that it is composed of a great number of cysts, varying in size from that of a walnut to a minuteness which barely permits recognition.    The microscope often shows the existence of many others of still smaller size.    These cysts are held together by a fibrous stroma, in the meshes of which they lie, and which is chiefly composed of white fibrous, intermingled with a little yellow elastic tissue.    The walls of the cysts are, like those of other cysts, composed of delicate fibrous tissue;

contain a peculiar semi-solid jelly-like substance, the "Colloid matter," which is of a variable tenacity, and colorless, or of a yellowish hue, as a general rule, though sometimes greenish or tinged with blood.

Named Colloid from its external resemblance to thick size or glue, the colloid substance does not, however, contain any gelatine, as it was formerly supposed to do, but is quite sui generis. Its precise chemical nature is unknown. Under the microscope it is quite structureless, or may contain various floating bodies, and especially the so-called colloid corpuscles.

The whole of the tumor may present the anatomical conditions above described, or a part of the growth may possess these characters and a part present the character of some other growth, and especially of medullary cancer.

**Diagnosis.**—As a general rule, it is not possible to diagnose this disease until the morbid mass is exposed for anatomical investigation by the death of the patient, or, if the tumor is situated externally, by its removal. A section of the growth will then at once reveal its character, even to the naked eye.

**Prognosis.**—Where a colloid tumor is removed from some external organ a very guarded opinion should be expressed as to the probable return of the disease, for although perhaps in some cases the disorder is quite innocent, yet in the majority of cases it returns after extirpation, and pursues the usual cancerous history.

**Treatment.**—The treatment of the other varieties of carcinoma applies equally to this.

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# CHAPTER IV.

## SPECIAL SEATS OF CANCER.

### SECTION I.

#### CANCER OF THE SKIN.

Any of the varieties of cancer before described may exist primarily in connection with the *skin;* but the great majority of primary skin cancers belong to the type of ulcerated **Epithelioma,** before described. When true scirrhus or medullary cancer occurs in the skin, it is generally in consequence of the extension of the disease from some deeper-seated part, as, for example, the mammary or parotid glands. Melanotic cancer of the skin, though perhaps the most frequent form of melanotic cancer, is a rare affection, while colloid cancer is yet more rare. Either of the latter presents the characters of melanosis or colloid as described elsewhere.

**Symptoms.**—Epithelial cancer of the skin may occur upon any part of the body, but its most frequent seats are the alæ of the nose, the edge of the lip, especially the lower lip, the skin of the forehead, the internal canthus of the eye, the labia majora, and the scrotum and prepuce. Commencing by an epidermic or epithelial induration, cancer of the skin sometimes presents the symptoms detailed under benignant epithelioma, but is more obstinate, readily inflames, and soon runs on to an ulceration which is very difficult to heal. This ulcer progresses more rapidly in extent than in depth, and is accompanied by marked induration of the edges, together with numerous papillary projections of irregular size and shape, thus giving it an appearance of depth. As the disease progresses, the patient complains of burning, stinging, prick-

ing pain, though this is often less marked than in some of the other forms of cancer, and is sometimes absent, though it is also sometimes quite severe. In other cases a true scirrhus or encephaloid growth is developed in the skin in connection with some of its follicles, and is soon accompanied by enlargement of the adjacent lymphatic glands.

The disease designated by dermatologists as "Molluscum Contagiosum" may, I think, be justly regarded as encephaloid cancer of the skin—a careful microscopical examination as well as clinical history having shown this in some cases, a special example of which I have given in detail.*

**Diagnosis.**—Cancer of the skin differs from benignant epithelioma in presenting the characteristic symptoms of cancer, which ulcerated benignant epithelioma rarely does. Sometimes commencing by a scaly incrustation, true cancer of the skin also shows itself as a shot-like induration, though the main difference between epithelioma, as before described, and many cases of skin cancer, unless encephaloid, is found in its more rapid progress and tendency to induce adjacent disorder of the lymphatics. From chancre it may be told by comparing it with the description given of the former under the head of Syphilis.

**Prognosis.**—The prognosis of skin cancer is more favorable than that of any other form of cancer, yet it should always be regarded with suspicion as liable to progress like cancer in other tissues. Extirpation, either by the knife or caustic, is, however, much less rarely followed by a return of the disorder than in the other forms of cancer; hence the disposition sometimes seen to regard skin cancer as a mild variety of carcinoma, and to distinguish it as having a tendency to cancer indicated by the term **Cancroid**, rather than describe it as well-developed cancer.

**Treatment.**—Skin cancer, (scirrhus,) like benignant epithelioma, may be removed either by the knife or caustic, the selection of the knife rather than caustic being decided by the locality, and the certainty of removing a circumscribing portion of sound tissue. It is, however, especially in skin cancer, as before stated, that the treatment by caustics has long been regarded as specially applicable. Unfortunately the use of caustics has become, in the public mind, associated with the treatment of "cancer curers," and many patients who dread the knife seek, therefore, these irregular and often exceedingly ignorant practitioners, rather than consult or submit to treatment by a surgeon. As caustics judiciously applied are capable of doing much good, and patients may thus be preserved from the serious injury inflicted on them by pretenders to surgical skill, their employment deserves more attention than they have until lately received from the profession in the United States. The use of a valuable remedy by a knave is certainly no objection to its employment by an honest man, and it is in the power of the profession to withdraw many persons from the hands of empirics by recommending more frequently the use of caustics in proper cases, when there are insuperable objections on the part of the patient to other modes of treatment.

Caustics have, at various periods, enjoyed considerable reputation in the treatment especially of the so-called "malignant ulcers" of the skin. I think it, therefore, useful to recall some of the older formulæ from oblivion, that the student may know their true value, while also referring to the more recent improved combinations.

**Treatment of Skin Cancer and Epithelioma by Caustic.**—In the application of caustics to the skin, the vitality of the tissue is destroyed by the

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* American Journal Medical Sciences, No. xliv. p. 396, October, 1851.

abstraction of its moisture; inflammatory action in the adjacent parts is established; a slough is created, and the dead portion, or that on which the caustic has acted, is ultimately thrown off, thus leaving an ulcer which is often tardy in cicatrizing, though sometimes also healing quickly. As the tissue to be destroyed often possesses increased vitality, the sensibility of adjacent parts is increased, and the application of the caustic develops excruciating pain, unless a limited amount is applied. Hence repeated applications of the caustic are often necessary, as the degree and continuance of the pain is infinitely greater from the use of caustics than that which results from the knife.

On the other hand, the advocates of caustics contend that the new or abnormal growth, being disposed to degeneration, loses its vitality sooner than normal healthy tissue, and that caustics consequently eradicate the disease more thoroughly than the knife, the operator being unable to recognize the commencing degeneration of adjacent tissues.

When a skin or other cancer has been removed and reappears in the cicatrix, the use of caustics, in my experience, is highly beneficial, more so than a second ablation; and to encourage their use by surgeons, and remove them from the hands of quacks, I present a few of the formulæ often resorted to.

**Frere Cosme's Caustic,** which is a very ancient one, is formed thus :—

R.—Acid arsenios, ℨj;
Hydrarg. bi-sulphuret, ℨj;
Pul. carbon, ℨss. M.

Make into a paste with water, and spread directly on the part, or spread on kid or linen, and apply as a plaster. If the surface is large, only cover a portion of the sore, to avoid pain and guard against the risks of poisoning from absorption of the arsenic.

**Helmund's Powder,** which is very similar in its composition to Frère Cosme's paste, is formed as follows :—

R.—Acid arsenios, ℈ij;
Cinnabar, ℨij;
Pulv. carb. lig. grs. xij;
Sang. draconi, grs. xvi. M.

The purpose of the charcoal in this preparation is to correct the fetor of the slough, while the dragon's blood is probably used merely to conceal the other constituents. It should be applied to the sore or tumor either by mixing it with one ounce of resin cerate, or with one ounce of the following ointment, which, it may be perceived, from its composition and name—the **Narcotico-Balsamic Ointment**—is a mixed prescription :—

R.—Balsam Peru,
Ext. hyoscyam. āā ℥ss;
Plumb. acet. ℈iv;
Tr. opii, ℳxl;
Ung. cetac. ℥iv. M.

In the application of these caustics to a cancerous growth, they should be spread upon a piece of lint of such a size as will cover the whole sore, and extend a little beyond its edges, when it should be fastened down by strips of adhesive plaster, and covered by a compress and bandage. During the first hour, perhaps, it will produce little irritation; but after four, six, or eight hours, the pain will become more severe, and subsequently so violent that it may be found necessary to give an anodyne to alleviate the suffering.

After a lapse of forty-eight hours the caustic plaster may be removed and another put in its place, if the slough is not deep enough; but after obtaining a white, felt-like slough, of sufficient depth, it only remains to favor its separation by the use of poultices or the warm water-dressing, repeating them until the slough comes away, when the ulcer that is left should be dressed with the narcotico-balsamic ointment, or with simple cerate, or basilicon, which answers the purpose quite as well.

Sometimes it happens that while the slough is separating, the odor of it is very offensive, and to counteract this the parts should be washed with the following lotion :—

> ℞.—Potassæ sulph. ℨj;
> Aq. rosæ, f ℥iv;
> Ext. hyoscyam. ℨj.   M.

The extract of hyoscyamus aids in allaying the pain.

Another caustic, which was once quite celebrated, is **Justamond's Powder**, which is as follows :—

> ℞.—Oxid. antimon. 1 part;
> Acid, arsenios, 2 parts.

To which equal parts—or three parts—of opium are to be added.  Justamond applied this powder by making it into a paste with the white of eggs, and smearing it over the sore with a spatula.

A notorious and old cancer prescription, much used in Philadelphia and New York, is the *Red Ointment* of certain unprincipled men.  It is evidently the same as Dubois's paste, and is the basis of most of the quack prescriptions at present in use.*   Its composition is as follows :—

> ℞.—Hydrarg. sulphuret, ℨj;
> Acid, arsenios, ℥ss;
> Sang. draconi, ℥ss;
> Ung. cetacei, ℥j.   M.

**Manec's Paste.**—This modification of the above formula has recently been lauded by M. Manec, a well-known surgeon of Paris.

> ℞.—Acid, arsenios, grs. xv;
> Hydrarg. bisulph. grs. lxxv;
> Pul. spongiæ, ustæ, grs. xxxv.   M.

Apply as a paste, when moistened with water.

**Canquoin's Paste—**

> ℞.—Zinci chloridi,
> Farinæ, equal parts, or 1 to 2, or 1 to 3, as demanded for activity.

Moisten very slightly, and apply as before.

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* In the use of this paste the patient is directed to spread the ointment on a piece of rag, and apply it to the sore, changing the plasters from day to day till the areolar attachments of the tumor loosen and come away, or, as the quacks and the vulgar say, till "the cancer comes out by the roots."

They then apply the *Brown ointment* over the sore thus left.   This, also, is an old prescription, and is simply a mild, soothing ointment.

> ℞.—Litharge, ℈j;
> Ol. lini, f ℥iij;
> Cerat. resin, ℥j.   M.

This caustic is very deliquescent, will not keep, and is liable to cause hemorrhage.    The depth of the slough will depend somewhat on the thickness of the layer of caustic applied.

For the prompt formation of the chloride of zinc, see p. 394.

**Ure, of England,** employed the following formula :—

> R.—Zinci chloridi, Əj ;
>     Farinæ, ʒj ;
>     Ext. aconit. ʒss ;
>     Cerat. simplex, ʒj.    M.

**Vienna Paste** consists of 5 parts of caustic potassa and 6 parts of quicklime powdered and well mixed together, then diluted with a little brandy or Cologne water, till it forms a paste, which should be applied as before described.

The Vienna paste acts very promptly, in a few minutes ; does not create continued suffering ; and does not, as some of the preceding caustics, require the vesication of a blister to remove the cuticle to expedite its action.

**Landolfi's Caustic** is composed thus :—

> R.—Bromin. chlorid. 3 parts ;
>     Zinci        "      2 parts ;
>     Antimon. "      1 part ;
>     Pul. rad. glycyrrhiz, 1 part.    M.

This caustic was at one time lauded, but failed in the hands of a committee of investigation, at the Salpetrière Hospital, in Paris, in 1857.    It is extremely suffocating when breathed.

Another recent caustic, highly lauded, but with which I have had no experience, consists of the following :—

> R.—Calcis sulphat. ʒiij ;
>     Zinci chlorid,
>     Antimon. chlorid. āā ʒj.    M.

Moisten, and apply as a paste or plaster.

**Fell's Caustic—**

> R.—Pul. rad. sanguinar Canaden, ʒj ;
>     Zinci chlorid. ʒij ;
>     Aquæ, f ʒij.

Mix, and form a paste as thick as treacle, then apply on strips of linen, subsequently scarifying the slough and introducing the strips, if the desired depth and extent of slough is not first obtained.

This caustic, rendered celebrated by the notorious puffs, etc. of the so-called inventor, was submitted to trial in the wards of the Middlesex Hospital, London, and its action noted by a committee of surgeons, whose devotion to the interests of humanity thus gave a temporary notoriety to an adventurer.    Their report showed its activity as a caustic — this evidently depending on the chloride of zinc, an article long before known as a caustic. The committee also showed the frightful suffering that it caused in most of the cases, when applied to remove cancer of the breast.    But among the evils resulting from their condescension in investigating the bold claims of a cancer curer, is found the one useful idea of incising a slough to the full depth, then introducing slips of fresh caustic, so as to act more deeply and promptly than had formerly been done in the application of this class of remedies.

Dried and finely-powdered sulphate of zinc, as suggested by Simpson,

of Edinburgh, I have found a mild yet efficient caustic to open cancer, but especially useful in cancroid disease of the lip and uterus.

The bichloride of mercury has also enjoyed some reputation, and, as a caustic of less activity than the arsenical and mineral acids, may sometimes be resorted to on surfaces deprived of epithelium. In the following proportions I have employed it advantageously in the treatment of nœvi, as suggested by Dr. Mackay, of Edinburgh:—

> ℞.—Hydrarg. bichlorid. 4 parts;
> Collodion, 30 parts.   M.

Paint it well on the part; four hours afterward apply the warm water-dressing. The eschar will slough out in from three to six days.

The concentrated mineral acids have also been highly lauded by some surgeons, especially the pernitrate of mercury and the strong sulphuric acid. The latter, made into a paste with powdered saffron, has been extolled by Velpeau as quickly converting the part into an eschar, and thus diminishing the duration of the suffering usually induced by caustics. Saw-dust and sulphuric acid acts equally as well, and has been lauded by Syme—the surrounding parts being protected by a solution of gutta-percha in chloroform. Sulphate of zinc, mixed into a paste, with sulphuric acid, so as to create a persulphate, has been suggested by Thomson, and recently recommended by Simpson, of Edinburgh.* Simpson saturates strong sulphuric acid with a quantity of dried sulphate of zinc, and, dipping a quill pen into the mixture, draws a number of lines across the tumor, the number corresponding to the size of the tumor to be destroyed. . The skin being thus quickly destroyed, scratching with the pen soon makes a fissure, which should then be filled with the paste and left for a day or two, when, by a renewed application, the action may be carried to any depth, five or six days sufficing for the removal of a good-sized tumor. At the first application, he makes the fissure about one-fourth or three-eighths of an inch deep. This caustic, he thinks, is less painful than the others, as the acid promptly chars the tissue, while the zinc keeps the parts soft and pliable. The exposed tissue or ulcer should be subsequently dressed—before or after the tumor is enucleated—with black wash or any appropriate stimulating lotion. Chloride of zinc may be readily made extemporaneously, as suggested by Spence, of England,† by dissolving fifty grains of prepared chalk in two drachms, by measure, of commercial muriatic acid, and by dissolving one hundred and fifty grains of sulphate of zinc in two fluid drachms of boiling water. Then, when required for use, mix the two solutions, and a paste weighing near an ounce, and containing about one-sixth of pure chloride of zinc, will result. Chromic acid is a milder caustic, especially useful on warts of the penis, skin, etc.

**General Remarks on Caustics.**—The selection of one caustic rather than another is a point often regulated by individual experience.

As a general rule, all the arsenical caustics will be found to be very active, particularly when applied to a surface denuded of its cuticle, and also very painful. They have been long employed, especially in the belief that they not only destroy thoroughly the morbid structure to which they are applied, but also extend their action to the morbid tissue several lines beyond the circle of the application.

Manec has urged this latter peculiarity in their favor. Although arsenical caustics are very indiscriminately employed by charlatans, and the irritation they create seems to prevent the absorption of a dangerous amount into

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* Lectures on Diseases of Women.            † London Lancet.

the system, yet it should be recollected that in some instances serious consti-
tutional disturbance has been noted after their use, even in small quantities.

To guard against this, it has been judiciously advised by Manec to limit
the amount of the plaster made of his paste, to a circle of the size of a
twenty-five cent piece, and to analyze the urine from day to day to see when
the elimination ceases.  If the absorption has been rapid, this will be noted
from the fourth to the sixth day, or, perhaps, the seventh or eighth, if ap-
plied to an indurated mass, like scirrhus.  Then, on the tenth day, if the
urine gives no evidence of its presence, a new application may be made.

The caustic which has the longest maintained professional favor as safe
and sure, is the Vienna paste, though it is liable to be followed in vascular
parts by secondary hemorrhage; hence the mineral acids, when their action is
well restricted, are preferable in ulcerated cancers, and those disposed to bleed.

When there is reason to doubt the effect of the loss of blood, Canquoin's
paste may be advantageously used, the astringency being valuable.  Mai-
sonneuve, of Paris, forms "caustic arrows," or small cones of chloride of zinc
paste, making, when necessary, punctured wounds into the tumor all round
its base, and introducing an arrow into each wound.  In the frequent appli-
cation of caustics, I have, however, never been troubled by hemorrhage, and
generally resort at first to the chloride of zinc, modifying its strength so as
to commence with it in the proportion of one part of the zinc to five parts of
flour, unless I can readily see the patient.  When able to watch the action
in a circumscribed application, equal parts may be usefully resorted to.  I
have had no experience in the use of the sulphate of zinc and sulphuric acid
as employed by Simpson, of Edinburgh, but should certainly give it a trial,
on his evidence, as being the· least painful, and most prompt and efficient.
When hemorrhage supervenes on the use of any caustic, the application of
the persulphate of iron will generally check it.

In every instance, in applying caustics, it is but right to forewarn the
patient of the probable suffering, and anæsthesia may be employed to blunt
this during their direct application to an ulcerated surface, though insensi-
bility cannot safely be maintained over an hour and a half, and only for this
time, by carefully watching the pulse and the respiration.  At other times,
narcotics should be freely given, both before and after the application of the
caustic.

Under simple or stimulating water-dressings, according to circumstances,
the sloughs separate, and the resulting ulcer cicatrizes more or less rapidly—
least so in the ulcers left from the metallic caustics; more rapidly after the
use of the acids and their compounds.

## SECTION II.

### CARCINOMA OF THE EYEBALL.

The varieties of cancer seen in the eyeball are scirrhus, encephaloid, and
melanotic.  Of these, melanotic and encephaloid are by far the most com-
mon, though scirrhus is sometimes met with.

### ¿ 1.—Scirrhus.

**Symptoms.**—Scirrhus of the eyeball is an exceedingly rare disorder, and
occurs generally in the middle aged, and old.  It progresses more slowly
than the medullary or melanotic variety, and does not attain the same bulk.

Occasionally the first indication of the approaching inroad of the disorder will be the patient complaining of dimness of vision, or of some slight weakness of the eye, as shown by increased lachrymation and moderate turgescence of the conjunctival and sclerotic vessels.  Attention thus drawn to the organ, the surgeon sometimes will see, behind the iris, a peculiar tint which resembles the lustre of metal.

As the disease slowly progresses, the pupil becomes dilated and immovable; the iris changes its color, and at last a solid substance shows itself through the pupil, distends the coats of the eye by growing forward, and protrudes the ball by growing backward, till, at length, the cornea and other coats burst, and bloody granulations make their appearance.  Meantime the lids are distended and ulcerate, but the tumor never attains the size of encephaloid disease, and is less vascular.

**Diagnosis.**—In the early stages of this disease, it may be confounded with various affections of the eye, but eventually the appearance of the tumor within the ball dispels all doubt.  The diagnosis from medullary carcinoma is stated below.

Scirrhus usually commences in the anterior portion of the eye, and travels backward, creating a tumor of moderate size.  Soft cancer commences within, and progresses forward, until it bursts the cornea, and develops a fungus.

Hard cancer of the eye usually occurs in the aged, soft cancer in the young, though this is not invariably the case, yet it will aid the diagnosis as a general rule.

**Prognosis.**—That of the same varieties of cancer elsewhere.

**Treatment.**—The operation of extirpation of the eyeball will be given in vol. ii.

### § 2.—Medullary Carcinoma, or Fungus of the Eye.

**Medullary Carcinoma of the Eyeball** is not a very common disorder, yet it is seen more frequently than scirrhus of the same organ.  It is also found in a different class of patients; scirrhus of the eye being seen in the aged, medullary carcinoma almost always in children, and most frequently in those beautiful fair-skinned, fine-haired, blue-eyed children, whose beauty, though too sure an evidence of the scrofulous taint, is so attractive.

**Symptoms.**—Often the first indication of the approaching inroad of medullary disease of the eye will be that the little patient complains of dimness of vision or of some slight weakness of the eye, which is shown in increased lachrymation and moderate turgescence of the superficial vessels, that is often supposed to be simple ophthalmia.  Attention being thus drawn to the organ, the surgeon will note the appearance in the posterior chamber which resembles polished iron, and is analogous to that seen in scirrhus.  As the disease progresses, the symptoms resemble closely those of scirrhus; the iris changes its color, and a solid substance shows itself through the pupil, rapidly distends the coats of the eye by growing forward, and protrudes the ball by growing backward, till at length the cornea and other coats of the eye burst, and a bloody fungus makes its appearance, and soon attains marked volume, and death follows, either from extension of the disorder to the brain or from hectic.

**Diagnosis.**—Medullary carcinoma may be distinguished from hard cancer of the eye by the difference in the age of the patient affected, by the fact that hard cancer commences in the anterior structures of the eye or of the orbit, such as the conjunctiva or cornea, or the lids, lachrymal gland, etc.; while medullary carcinoma begins in the posterior part of the ball, as in the choroid coat and retina, growing from behind forward.  The size of the

tumors is also different, the medullary carcinoma creating the greatest vascularity of the skin over it.

**Prognosis.**—The prognosis is unfavorable.

**Treatment.**—Some temporary relief may be afforded by extirpation of the entire eyeball in certain cases, but the disease will, usually, return and carry off the sufferer.

## SECTION III.

### CANCER OF THE LIP.

**Cancer of the Lip** may be either malignant epithelioma or true scirrhus. It shows itself generally on the lower lip, and most frequently at its edge, as on the everted portion of the mucous membrane, though sometimes it commences lower down, between the margin of the lip and the edge of the chin in the locality of the labial glands.

**Symptoms.**—The symptoms of this form of cancer are as follows: When the cancerous deposit is developed at the edge of the lip, it shows itself in the two forms just mentioned. In malignant epithelioma it appears only as a slight scale, due to the degeneration of the epithelial structure of the part, which, separating, leaves a superficial ulceration or crack, from which a fungous granulation or two is very apt to spring; in scirrhus the disease commences in the thickness of the lip, the first thing noticed being the presence of a little shot-like body beneath the skin, which is quite movable in the tissues of the lip. In this latter form, it is probable that the cancerous deposit has taken place in some of the labial glands. As this little tumor enlarges, it distends the skin, and the integuments take on ulcerative action, creating the everted edges and peculiar appearance of the cancerous ulcer, and destroying the entire lip. As the disease advances, irritation of the glands of the neck appears; the tumor spreads, and the patient at last sinks under the effects of hectic fever. Before this termination, however, the ulceration may extend itself to a frightful degree, I having known it in some cases to remove the whole lower lip, lay bare the jaw, and produce a hideous change in the features.

**Etiology.**—The exciting cause of this form of cancer is to be found in local irritation of any kind, the biting of the lip being sometimes sufficient to create it in those predisposed to the deposit. Smoking of a clay pipe has also been said to excite it, and the meerschaum mouth-piece for cigars, now so fashionable; but this practice cannot exert any influence of a specific character, the use of both being very common, and this form of cancer comparatively rare.

**Diagnosis.**—The diagnosis of cancer of the lip is generally easy. Sometimes, however, a simple ulcer of the lip, such as that which results from a chap or a fissure, and which it becomes difficult to heal—in consequence of the flow of the saliva over it washing away the reparative lymph—might create a doubt of its true character; but the history of the case, and the absence of any very great amount of irritation in the lymphatic glands of the neck, will generally show the simple character of the latter, and distinguish it from cancer. So, again, difficulty may occur in the diagnosis of cancer of the lip from the syphilitic ulcer or chancre, although the occurrence of chancre on the tongue or lip is not so common in this country as it is in France.

**Prognosis.**—The prognosis of scirrhus of the lip is serious; and the opinion of a positive cure should be very cautiously given; the general belief that this seat of cancer, when unaided by surgical treatment, proves

fatal in about three years, and that if excised it is apt to return in a few months, being quite in accordance with the most extended experience of surgeons.    But the removal of cancer of the lip by an operation is much more desirable than the operations of extirpation elsewhere, because, although the excision may not cure the disease, it removes a disgusting source of irritation, prevents foul matters from passing into the stomach, and generally prolongs life.    In malignant epithelioma the prognosis is more favorable.

**Treatment.**—The operation that is required for the removal of scirrhus of the lip depends upon the extent of the disease.    If the whole lip has been destroyed, and the surgeon ventures to excise the edges of the ulcer, a plastic operation will be required—the mode of performing which will be found in vol. ii.    Where, however, the deposit is smaller, it may be removed by excising a V-shaped piece containing the cancer, and also a broad margin of the healthy structures, the wound being subsequently closed with hare-lip sutures.    After the operation, though the patient may be well for about two years, yet the disease is very apt to return.    In epithelioma the best treatment is to dust the surface with dry, powdered sulphate of zinc, as advised by Simpson, of Edinburgh, and cover it with a morsel of dry lint, made to adhere by collodion.    From this I have had much satisfaction.

## SECTION IV.

### CANCER OF THE TONGUE.

**Symptoms.**—Cancer sometimes shows itself in the tongue, where it is presented in the form of a small tumor, which is first seen as a little flattened circumscribed swelling, situated generally opposite the first molar tooth. Or it may be a more extensive induration of tissue, accompanied by a superficial ulceration, from which fungous granulations sprout, the pus of which, being swallowed to a greater or less extent, soon aids in contaminating the system.

**Etiology.**—Any local irritation may cause cancer of the tongue in those predisposed to it, as the contact of hot liquids when taken suddenly into the mouth, or the rough edge of a tooth, or frequent pinching of the tongue in convulsions, etc.

**Diagnosis.**—The diagnosis is to be based on the characters already detailed in connection with carcinoma generally.

**Prognosis.**—The prognosis of cancer of the tongue is much more unfavorable than that of cancer of the lip, from the fact that the matters swallowed more certainly disorder the digestive apparatus, and thus aid the disease in breaking down the patient.

**Treatment.**—The apparently *radical* treatment of cancer of the tongue consists in removing, as far as possible, all sources of irritation, by filing off the rough edge of the teeth, and giving the patient a mouth wash of honey and alum, which also contains ʒss extract of cicuta to every six ounces of the wash, or by cautiously applying the sulphate of zinc and then the wash. If the glands beneath the tongue enlarge and become painful they may be leeched, and the ulcer on the tongue be touched with a strong solution of muriatic acid or nitrate of silver, or the paste of the persulphate of zinc. Earl, of England, has highly recommended touching this ulcer with a solution of arsenious acid, but this would require to be cautiously employed lest the poisonous effects of arsenic be induced.

If the knife is used, the organ should be steadied by transfixing it by a tenaculum, which an assistant may hold, while the surgeon removes the dis-

eased parts, ligates the arteries, and closes the wound by sutures.* As the wound heals, the granulations, if disposed to be too luxuriant, may be touched with nitrate of silver.

**Ligation of the lingual artery** has also been recommended as a curative measure; the mode in which it is performed being stated in vol. ii.

## SECTION V.

### CANCER OF THE PAROTID GLAND.

**Cancer of the Parotid Gland** is a complaint occasionally seen. Generally, however, the cancerous deposit is at first made not in the gland itself, but in the lymphatic glands exterior to it; and this observation is equally applicable to all the salivary glands. As the lymphatic gland at first affected becomes enlarged, it soon invades the proper structure of the parotid, and the whole becomes one indistinguishable mass of disease, creating a tumor directly in the parotid region. This tumor, when scirrhous, is not very bulky, being generally not larger than the fist, and bound down by the dense fascia of the part. It, therefore, progresses inwardly to such an extent as to compress and sometimes completely obliterate the carotid artery; so that in operating in these cases it has occasionally been unnecessary to tie the external carotid after it was cut, the hemorrhage from the operation of extirpation being much less than might under ordinary circumstances be expected.

**Encephaloid deposit** in the parotid gland presents a tumor of much greater size than scirrhus, and in other respects follows the general course previously described in the remarks on Soft Cancer.

**Diagnosis.**—The diagnosis here is of little practical importance.

**Prognosis.**—The prognosis of this tumor when left to itself is generally unfavorable, the disease being exceedingly apt to run its course within eighteen months.

**Treatment.**—The palliative treatment is the same as that already detailed under the general head of Carcinoma. In regard to the so-called curative treatment, it may be attempted by the ligation of the carotid artery, but generally the collateral circulation is so soon re-established that this affords only temporary benefit, and the extirpation of the tumor is therefore more reliable. For the details of the operation, see vol. ii.

## SECTION VI.

### CANCER OF THE MAMMARY GLAND.

Any of the varieties of cancer, but especially hard, soft, and colloid cancer, may occur in connection with the mammary gland. Of these, hard cancer is infinitely the most frequent.

**General Characters and History of Hard Cancer of the Breast.**—Scirrhus of the breast shows itself as a small tumor, which is generally seated not far from the nipple. It commences with a small distinct lump, which runs its course either with great rapidity or remains indolent for months or years. When it becomes active, the first symptom is generally a lancinating or an exceedingly distressing burning pain. At first the tumor is quite movable, but at an early period it will be observed that although movable WITH the gland it is not movable IN it. As the tumor enlarges, it contracts

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* See vol. ii. for operative details.

adhesions to the skin, the nipple becomes retracted, Fig. 183, the super-

Fig. 183.



ficial blood-vessels are distended, the skin cracks, and a thin serous discharge flows from the fissures; ulceration then ensues, often complicated with sloughing, and the skin becomes puckered around the sore, from which flows a most offensive and irritating discharge. The morbid mass now becomes adherent to the pectoral muscle; the axillary, and sometimes the cervical lymphatic glands enlarge; constitutional symptoms develop themselves as in other cancers, and the patient dies exhausted, or perishes more suddenly from a fatal hemorrhage. The female breast is more frequently the seat of scirrhus than any other organ in the body; and indeed most of the descriptions of this variety of cancer found in systematic treatises on the subject have been drawn from the phenomena of the disease as manifested in this organ. As might be anticipated from its imperfectly developed condition, the mammary gland of the male is rarely attacked.
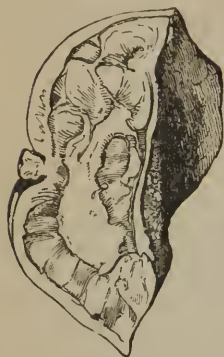
Cancer seldom occurs in the female breast until about the period of the cessation of the menstrual discharge, and especially between the age of forty-five and fifty; this is well illustrated in the following table from Paget :—

Of 158 cases of cancer of the breast—

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 were first observed between............................. | 20 and 25 years of age. |
| 4 | " | " | " | .............. ........... | 25 and 30 | " | " |
| 9 | " | " | " | .. ........................ | 30 and 35 | " | " |
| 26 | " | " | " | ............................. | 35 and 40 | " | " |
| 33 | " | " | " | ............................. | 40 and 45 | " | " |
| 40 | " | " | " | ............. ............... | 45 and 50 | " | " |
| 17 | " | " | " | ............................. | 50 and 55 | " | " |
| 11 | " | " | " | ............................. | 55 and 60 | " | " |
| 9 | " | " | " | ............................. | 60 and 70 | " | " |
| 6 | " | " | " | ............................. | 70 and 80 | " | " |
| 1 | " | " | above............................. | 80* |

According to Sibley the average age of 156 patients at the time of the first appearance of cancer of the breast was 48·6.

It is not to be understood, however, that the cessation of the menses has any genetic connection with cancer, since, as shown by Paget's tables, in the majority of instances, cancer is developed either some time before or some time after the change of life, the number of instances in which cancer was first observed in the same year as the cessation of the menses being less than one-sixth of the whole number of cases observed.†

Single women are popularly regarded as more liable to the disease than the married. This idea, however, is contradicted by the statistics of Sibley above alluded to ‡ Of the 416 cases of cancer in females reported by this gentleman, 83 per cent. either were or had been married; and 74 per cent. of the married women afflicted with cancer of the breast had borne children.

**General Characters and History of Soft Cancer of the Breast.**—According to Lebert,§ about one-fifth of the cancers of the breast belong to this variety; and Paget considers soft cancer of the breast to be even less frequent in England than Lebert's statement would make it appear in France. The tumor in this case grows far more rapidly than scirrhus— it is at first oval, rounded, or lobulated, and is with difficulty, if at all,

* Paget, p. 512.        † Loc. cit., 5 B.        ‡ Lancet, loc. cit.
§ Des Maladies Cancereuses, p. 326.

distinguished from certain benignant growths, as cartilaginous tumors, cysts, etc.; ultimately, however, the ulceration and sloughing which ensue, the character of the fungus which sprouts from the ulcerated surface, the enlargement of the axillary lymphatics, and other points detailed in the general remarks on soft cancer, will point out the true nature of the disease.

**Colloid Cancer,** when it occurs in the breast, presents nothing demanding special consideration beyond what has been said of its general characters in a previous section. (See COLLOID CANCER.)

**Diagnosis of Cancer of the Breast.**—Cancer of the breast occurs so frequently that its clinical diagnosis assumes the highest importance. Unfortunately, in many cases, and especially in the early stages of the disorder, the difficulties are so great as to render correct conclusions almost impossible; still, careful attention to the subject will enable the surgeon to arrive at correct conclusions in the majority of cases.

The diagnosis of cancer of the breast from other tumors may be made by the following comparison of its characters with those hereafter mentioned.

**Adenoma or Hypertrophy of the Mammary Gland** is only seen in the unmarried female; it is most apt to appear soon after puberty, and sometimes creates such a development of the organ as is almost incredible, some having been reported in which the gland hung down to the knees and weighed thirty pounds, and others having been forty-two inches in circumference. In a marked case that I have seen in Philadelphia, the breast reached nearly to the umbilicus, and was larger than a man's head, as tested by an attempt to surround the gland with a hat.

This complaint is universally admitted to be rare, and yields no further inconvenience than such as can be remedied by stays; it sometimes disappears on child-bearing. The natural appearance and feeling of the gland will usually prevent diagnostic errors.

The **Lipoma** or **Fatty Tumor,** or hypertrophy of the adipose and cellular tissues around the breast, is not intended to include the ordinary lipomatous growth which is occasionally seen in the breast, as well as elsewhere, and which is a circumscribed, lobulated, and pediculated tumor, but designates a rare form of disease, in which the adipose structure of the entire breast is much augmented, creating a mass of considerable size and of a broad base. This tumor is apparently dependent on an extreme development of the adipose cells in the interlobular septa of the breast as well as in the subcutaneous layer of fat. The mass is nearly always lobulated, or as if subdivided into numerous secondary masses, by the fibro-cellular septa, which create the lobules of the breast. When incised, there is seen an almost homogeneous mass furrowed by a few whitish fibrous bridles, intermixed with many glandular lobules, which are greasy and unctuous to the touch, of a yellow color, of the consistence of lard, and which may be broken down by the finger.

Warren* reports an instance of this kind of tumor which he removed, and which weighed eight pounds. No appreciable cause could be assigned for its production.

The **Fibro-plastic Tumor** is an abnormal development of the natural partitions and fibrous laminæ which separate or envelop the lobes of the breast, and is generally due to some inflammation which has previously existed, such as an acute or chronic mammary abscess. On examining the breast after this complaint, the gland is often found to be decidedly harder, less elastic, less lobulated, and more homogeneous than is the case in its natural condition. The subcutaneous areolar and fatty tissue, to-

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* On Tumors, p. 229.

gether with the divisions of the lobules, are now found to be confounded
in one regular mass, in the midst of which the natural structure of the gland
seems to be lost.   This disorder has been described by Sir Astley Cooper
and Warren as the chronic mammary tumor, and is difficult to distinguish
from the early stages of carcinoma.   It may, however, be diagnosticated
from scirrhus by the previous history showing that it was consequent on one
or more attacks of inflammation; by the absence of pain, heat, and redness;
by its density, by its mobility, notwithstanding the appearance of adhesions
between the tumor and the skin; by the good constitution of the patient
and her self-satisfied condition, as well as by its remaining stationary, rarely
or ever increasing.   This fibro-plastic tumor often disappears of itself by a
complete and gradual resolution, even after it has existed a long time;
seldom if ever degenerates, and does not generally demand operative inter-
ference.   In a patient, formerly under my treatment, the left breast was thus
indurated during a period of four years, as the consequence of an inflamma-
tion of the gland, which, in accordance with the advice of Cusack and other
surgeons of Dublin, has been untouched by the knife.   During two different
lactations, acute inflammation showed itself about the structure, the first
of which was relieved by an antiphlogistic and resolvent treatment, and in
the second by a free suppuration, which, though causing some diminution of
the surrounding enlargement, did not materially change the character of the
original deposit.

Enchondroma are rare, and may be known by their extreme hardness.

Scirrhous Tumors are usually seen between the ages of thirty and fifty;
often in those whose relatives have suffered from cancerous complaints.

Encephaloid Tumors occur in young subjects; are large and soft; con-
sist of two or more globular bodies; increase rapidly; ulcerate; create a
fungus, and bleed.

Symptoms.—After thus examining the characteristic appearances of mam-
mary tumors, as a class, there yet remains certain well-marked and widely-
received symptoms connected with carcinoma of the breast that demand a
more special reference, and the first of these is the *pain*.

Pain.—The pain of cancerous tumors in every tissue has ever been
regarded as characteristic; the shooting, lancinating, gnawing pain of
cancer, long a professional idea, being now generally understood by the
public.   A more careful examination of this symptom, aided by the micro-
scopical examination of extirpated tumors, has, however, modified this idea,
so that Velpeau, whose opinion is of the highest value, asserts :—*

1. "That in the breast, as elsewhere, all kinds of pain may be felt without
there being serious disorder, while there may also be the most marked forms
of cancer without the woman having experienced the least pain."

2. "Nothing is more dangerous than to estimate the gravity, malignancy,
or benignancy of any tumor by the intensity or absence of pain, though
these statements are only applicable to the early periods of the affection—
acute pain generally accompanying the later periods, though, then, other
specific appearances prevent a mistake."

Discharge from the Nipple.—To this discharge, to which I have already
alluded in the general consideration of cancer, p. 369, my attention was
called many years since by Dr. Anderson, an old and experienced practi-
tioner, residing near Haverford, Pennsylvania.   Notice was also taken of
it by Richard, in Paris, in 1852, and it has since been observed by others.
This discharge may be either a serous or bloody-colored serum, that escapes
from one or more of the lactiferous tubes, opening on the nipple.   In the

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* Maladie du Sein, 2d edit., p. 491.

few cases (four) where I noted it, the disease proved to be encephaloid. Richard regarded it, however, as evidence of the presence of "adenoid" tumors. Velpeau,* on the contrary, has met with it in cases attacked with cancer more frequently than in the benignant tumors, and explains it as resulting from the irritation and dilatation of certain of the lactiferous tubes, whose functions were impaired by the presence of the growth, which generally in his experience was malignant. I regard it, therefore, as a valuable addition to the other diagnostic signs of cancerous mammary tumors.

**Prognosis.**—The prognosis of carcinoma of the breast has been already alluded to.

**Treatment.**—The indications in the treatment of cancer of the breast are the same as those mentioned in the general treatment of carcinoma; but the frequent development of this disorder in the female breast, and the intense suffering, both mentally and physically, which it induces, demand a more special consideration at present. When a tumor presenting the hardness, pain, and other symptoms of scirrhus, forms in the breast, it should be regarded as a source of irritation, and it will be found to be good practice to leech it freely all *round* its base or a few lines *from it*, so as to abstract the blood without increasing the irritation in the tissue of the tumor. After free leeching, apply for twelve hours the warm water-dressing, or a warm poultice, giving the patient a thorough purge, and following it by a moderate dose of anodyne, such as Dover's powder. To retain a poultice or other warm dressing in position, and support the breast so as to prevent its dragging on the lymphatic vessels and the adjacent areolar tissue, fold a handkerchief into the shape of a triangle, and apply it as the triangular cap of the breast before described, page 157.

In order to diminish the pain, keep up the action of the perspiratory glands, and prevent the patient from handling the tumor, and thus increasing the flow of blood to the adjacent parts whence it draws the materials for its development, it will prove very useful to cover the breast with the emplastrum belladonnæ, or cicutæ, or opii, or the emplastrum saponis mixed with these anodynes, and spread on kid cut to fit the breast, the plaster being retained by means of the sling of the breast, Fig. 87, which is also useful in supporting the gland and exercising the gentle pressure of a well-applied bandage, page 141.

When the ulcerated stage of cancer is established, the sling may also be employed to retain lint wet with liquor sodæ chlorinat., or lint covered with the powdered carbonate of iron, or with ointments of cicuta or belladonna.

When cancer of the breast returns after an operation, it usually shows itself by the development of round masses of various sizes, in or near its original seat, as represented in Fig. 184. Such secondary tumors, as well as the primary growths, when small, may often be advantageously treated by the caustics previously advised; the caustic plasters as well as the warm water-dressings or poultices being subsequently retained in

Fig. 184.
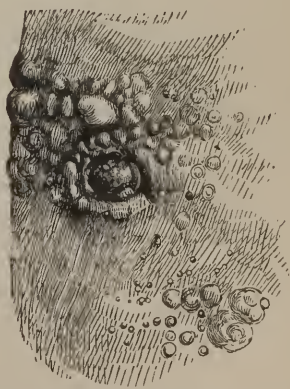


A view of the numerous Nodulated Tumors which often form in the cicatrix after the extirpation of the former growth. One is represented as ulcerated in the site of the mammilla. (After Miller.)

* Maladie du Sein, p. 493.

position by means of a broad band of muslin which encircles the breast and the waist, and is prevented from slipping down by the attachment behind and in front of two broad shoulder-straps, which are to be applied as a double T in the manner represented in Fig. 185.

Fig. 185.
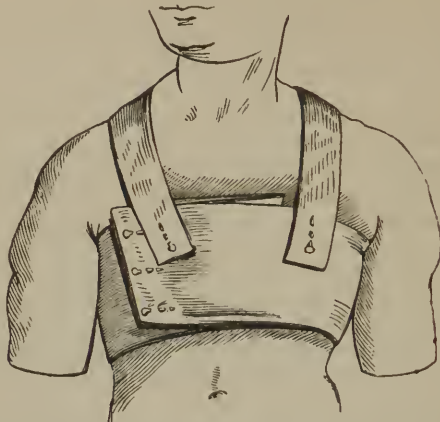


**Prognosis of the Operation.**—It appears, from the early observations of Leroy d'Etiolle, Lebert, and others, in regard to the prognosis of the operation for the extirpation of cancer of the breast, that the average duration of life after the operation was two years and six months, while the average duration of life without an operation was three years and six months.

Paget, however, makes the time shorter, and says* that of 66 cases which came under his notice, and in which the disorder was left to take its natural course without an operation, the average duration of life was about forty-nine months, and that the more tender the age of the patient, the more rapid was the progress of the disease. In 47 cases operated on, the duration of the disease was somewhat longer; he expresses therefore the opinion that the removal of the local disease makes no material difference in the *average* duration of life, but that the operation retards the progress of the more rapid cases. But neither Paget nor Lebert has seen a case in which its recurrence was delayed longer than eight years. Such cases, however, have been recorded in the United States, by Drs. Hartshorne and Parrish, of Philadelphia, in one of which the patient lived, free from the disease, for twenty years after the operation.

Out of 68 cases reported by Lebert, the disease returned after the operation in 23 cases, in from one to three months; in 22 cases, in between three and six months; in 8 cases, in between six and nine months; in 7 cases, in between twelve months and two years; in 3 cases, within three years; in 1 case, within four years; in 2, within six years; and in 2, in eight years.

Paget expresses the opinion† that the old rule of not operating when the lymphatic glands of the axilla are affected is a bad one, and he mentions cases to show that the operation will produce that temporary relief which alone is to be expected from it in these as well as in other cases.

"Thus, in 20 cases of the removal of the breast alone, the average recurrence of the disease was eight months, and death ensued within twenty-four

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months after the operation; while in 10 cases of the removal of the enlarged glands, the average time of recurrence was thirteen months, death taking place in twenty-four months, or about the same period as in the other cases. He also thinks there is no evidence to sustain the rule that ulcerated cancers, and those adherent to the skin, should not be operated on."

The use of caustics in the removal of scirrhous tumors is, it is said, more favorable in the prognosis than the operations thus alluded to; but sufficient data to establish this opinion have not yet been presented to the profession.

Summary.—The most judicious treatment of cancer of the breast is—1. To allay the local irritation and inflammation by means of leeches, warm water-dressings, anodyne plasters, and perfect rest of the arm of the affected side. 2. To improve the general health by purgatives, tonics, and chalybeates. 3. When, notwithstanding the employment of the preceding means, the tumor continues to be heavy, and is constantly painful, and a source of mental as well as bodily distress, to extirpate it, and any axillary glands that may be involved. 4. To remove small tumors by caustic. 5. To treat the reappearance of the disease by caustic.

## SECTION VII.

### CANCER OF THE PENIS.

Cancer may commence in the penis, either upon the prepuce or upon the glans, but especially upon the glans. It is most frequently of the epithelial variety, and occurs in men who have passed beyond the age of fifty years, in those who have suffered from phymosis, or in whom the part has been frequently and constantly irritated by accumulations of the smegma around the corona glandis. It is also seen in sailors, carpenters, and others whose occupations are such as to expose them to injuries of the penis by contusions from boards, ropes, the yard-arm of a vessel, etc. These causes, acting upon the penis of persons of a cancerous tendency, generally suffice for the development of the disorder.

Symptoms.—Cancer of the penis shows itself first as a small, hard wart or knot, in which there is no pain until it is irritated. It therefore, at first, not unfrequently causes the patient no mental uneasiness, and but little local pain. When irritated, however, the wart rapidly becomes painful, enlarges, ulcerates, extends, and creates a cancerous ulcer with everted edges and fungous irregular granulations, giving rise to an ichorous discharge that is extremely offensive, particularly if the patient is of filthy habits, or unable, from phymosis, to cleanse the parts thoroughly. In consequence of the swelling in this last case, the orifice of the prepuce sometimes contracts till the urine cannot pass through it; when, inflammation being developed, ulcerations occur at various points through the prepuce, by which the urine escapes, passing over and irritating the granulations which are formed in the reparative efforts. As the disease progresses, a train of symptoms appears which are such as might naturally be expected from the locality of the disease, such as shooting pains along the line of the lymphatics of the groin, and either in one or both groins. When the lymphatic glands become involved, pains are developed in the back, the glands of the lumbar region evidently participating in the disorder. The glands of the groin now usually begin to enlarge, the skin over them becomes distended; sloughing and ulceration ensue, and extensive cancerous ulcers form in this region. In the mean time, the usual constitutional symptoms of exhaustion have rapidly

progressed; the digestive organs become deranged, and the patient emaciates, until at last he dies worn out by hectic.

**Diagnosis.**—The diagnosis of cancer of the penis is a matter of some importance in reference to the operative treatment; thus it may be distinguished from venereal warts by the different color, by the ulceration, by the history of the case, by the hardness and weight of the cancer, and by the comparatively light, spongy character of the warts, etc. From phagedenic chancre, there could be but little difficulty in arriving at a correct diagnosis when a truthful previous history is obtained and the duration of the disorder is noted.

**Prognosis.**—The prognosis of a radical cure is unfavorable.

**Treatment.**—The treatment of cancer of the penis is based on precisely the same indications as the treatment of cancer elsewhere. It may, however, be stated, in regard to this seat of cancer, that the removal of the diseased growth is often advisable, as a general rule, by the use of caustic. When the disease is limited to the prepuce, the operation of circumcision may suffice for its removal; or it may even be useful to pare off the small portion of the glans penis that may be affected. But as the disease generally begins in this part, it is more certain, when the latter is much involved, to perform the operation of amputation of the body of the penis, as described in vol. ii. When, however, the glands of the groin are much involved, unless the penis has attained great size, which is rarely the case, it is not desirable to operate, as the inconvenience caused by the subsequent dribbling of the urine augments the patient's suffering when the disease reappears in the stump.

## SECTION VIII.

### CANCER OF THE TESTICLE.

**Cancer of the testicle** is a very rare affection, encephaloid disease or tumors of a benignant character being much more common. Great care is, therefore, necessary in the diagnosis, as it is sometimes advisable to remove the testicle for cancer, although it would seldom be desirable in the enlargement due to encephaloid disease.

**Diagnosis.**—Inflammation and induration of the testis, such as sometimes accompanies gonorrhœa, simple epididymitis, or the "hernia humoralis" of the old writers, may be confounded with cancer of the testicle; and so, indeed, may hæmatocele, or hydrocele, particularly if they are combined with ossification of the tunica vaginalis testis. These two latter cases, however, would be at once distinguished by an examination with an exploring needle. Another condition which requires care to diagnosticate from cancer is an effusion of lymph into the cavity of the tunica vaginalis testis, constituting what has generally been known as sarcocele. One such case occurring in the practice of a most intelligent surgeon is known, in which the testicle, which was perfectly sound, was removed in consequence of such a mistake. The absence of pain, of ulceration, of the enlarged glands, and the other symptoms of cancer should, however, suffice for a diagnosis. So, also, there may be a simple elephantiasis of the scrotum, such as occurred in the negro Nelson, whose scrotum was removed in 1837 by Dr. Picton, of New Orleans. This, however, may be diagnosed by its great bulk and by its indolent and painless character.

Sometimes it happens that the irritation produced by developing scirrhus will induce an effusion into the tunica vaginalis testis. Of course in such a

case it will be difficult to diagnose the presence of scirrhus until after the evacuation of the serum by a trocar. To this condition the name of Hydrosarcocele was given by the old writers.

**Symptoms.**—Cancer of the testicle begins sometimes like the epithelial variety of the scrotum, but it may commence in the shape of a small, hardened tumor, which enlarges, becomes painful, and involves the glands of the groin, just as cancer of the penis did. As it enlarges, the tumor invades the scrotum, which becomes adherent, tense, and ulcerated, after which the ordinary symptoms of open cancer ensue; but the ulcer in this case does not present a well-marked fungus; and by this fact, as well as by the smaller size of the tumor, cancer of the testicle can be readily diagnosed from encephaloid cancer.

**Prognosis.**—The prognosis of cancer of the testicle is unfavorable, extirpation being generally followed by a return of the disease.

**Treatment.**—From the prognosis it is apparent that the treatment of cancer of the testicle is only followed by temporary relief. There are, however, many cases in which the operation of castration, as described in vol. ii., is justifiable; yet, before resorting to so serious a measure, the diagnosis should be made with great certainty. There is, also, a true fungus of the testis, consisting of exuberant granulations, which, springing up from a scrofulous or syphilitic ulceration, may readily be cut down with escharotics, and then healed by the proper constitutional and local treatment, but which it is sometimes difficult to distinguish from cancer, unless close attention is given to the history and symptoms of the case. It may not be amiss to state here, with regard to any abscesses of this organ, that great care should be taken not to pick away sloughs from the cavity of the abscess after it has been opened either by nature or by the knife; the whole proper structure of the testis having been thus picked out in strings, and irreparable mischief done through want of experience in the operator. After the testicle has been removed for cancer, the patient will sometimes survive longer without a return of the disease than after any other operation for a similar deposit elsewhere.

During the existence of cancer, the enlarged state of the part, and the necessity of retaining a dressing upon it, render the use of the ordinary suspensory bandage impracticable. Under these circumstances, one formed of two handkerchiefs, and applied as directed by Mayor, page 159, Fig. 114, will prove very useful.

## SECTION IX.

### CANCER OF THE RECTUM.

Cancer sometimes shows itself in the rectum, where it occurs first as a deposit in the connective tissue beneath the mucous membrane, just above the internal sphincter muscle. As the disease progresses, the deposits of cancerous matter encroach upon the mucous membrane; it ulcerates, and a thin sanies or extremely offensive ichor is discharged, which excoriates the orifice of the anus and the parts adjacent. At the same time the symptoms of the cancerous diathesis make their appearance, and pain is experienced, both locally and in the back, from complication of the inguinal and lumbar glands.

**Scirrhus of the Rectum** may occur as a primary disorder or as the result of the extension of a pre-existing uterine or vesical cancer. **Encephaloid,** though rarer, may occur in the same manner. In either case a stricture of

the rectum is produced, impeding the passage of the feces, which are squeezed out through the contracted orifice in the form of a tape. At an early period ulceration occurs in the mucous membrane and invades the cancerous mass, but the growth of the abnormal tissue generally keeps pace with its destruction, so that no relief of the stricture is obtained. The discharge from the ulcerated surface is thin, offensive, and irritating, and excoriates the margin of the anus. As in these cases the evil effects of obstruction of the bowels are added to those which ordinarily occur in cancer, the disease rapidly progresses to a fatal issue.

**Colloid cancer** seldom occurs except as an extension from colloid cancer of the ovary.

**Epithelial cancer** of the anus sometimes occurs. It may be seated at some point within the internal sphincter, and may give rise to stricture and other symptoms similar to those of hard cancer. Or it may occur on the very margin of the anus where the skin and mucous membrane join and present papillary growths, not unlike those observed in epithelial cancer of the lip.

**Diagnosis.**—Cancer of the rectum may be mistaken for simple stricture of the rectum resulting from inflammation; for piles; for fistula in ano; for fissure of the anus, etc.; but it is to be distinguished from these complaints by the character of the discharge and of the constitutional symptoms.

**Prognosis.**—The prognosis of cancer, when thus seated, is decidedly bad, the patient's life being a mere question of time.

**Treatment.**—The treatment may be both local and constitutional, but chiefly constitutional. Thus, means should be taken to allay pain, to support the strength, and to keep the bowels free; while locally, means are required to prevent irritation of the diseased parts by the use of injections of a soothing character, and to correct the fetor of the discharge by the employment of disinfectants.

## SECTION X.

### CANCER OF THE UTERUS.

As **Cancer of the uterus** is very commonly alluded to by writers on the Diseases of Females it is unnecessary in a treatise like the present to enter into its details. In numerous instances benefit has been temporarily obtained from hastening the sloughing process by the application of the actual cautery heated to a red heat, or by the galvanic cautery alluded to on p. 194. In either case we should wait until the acute inflammation and tumefaction of the cervix has passed. Then, placing the patient on her back, with the hips raised and with a good light, introduce a prepared *bone* speculum, so that its mouth may embrace the neck of the uterus, and, cleansing the diseased surface by the application of a piece of sponge fastened on a stick, or by means of charpie held in shot forceps, apply for a few seconds the round cauterizing iron, taking care not to touch the sides of the speculum. On withdrawing the cautery, examine the os, and if any point of the ulceration has escaped, touch it again with the cautery, after which apply a little pledget of lint or charpie, well spread with cerate. Injections of tepid water should be freely used until the slough separates, when the healing may be aided by occasional touches with the nitrate of silver. In the early stages of the rodent or cancroid ulcer, the application, by means of a speculum and a camel's-hair pencil, of the powdered and dry sulphate of zinc, every fifth or sixth day, will prove satisfactory. Excision of the neck and extirpation of the uterus will be described in vol. ii.

# AMERICAN PAPERS ON TUMORS, CANCER, ETC.

## TUMORS.

Case of Nævus Maternus terminating in Aneurism by Anastomosis, cured by an Operation, (extirpation,) by Horatio G. Jameson, M.D.—*Maryland Med. Record*, vol. ii. p. 105.                    1831.

Telangiectasis, being a Report of Cases treated, (by white-hot needles, ligature, etc.) by George Bushe, M.D. New York.—*N. Y. Medico-Chirurgical Bulletin*, vol. i. p. 49.                    1832.

Two Cases of Tumors on the Head of Newborn Children, (Cephalæmatoma,) treated by Puncture, successfully, by R. N. Allen, M.D. Maryland.—*Maryland Med. Record*, vol. iii. p. 257.        1832.

Case of Extraordinary Tumor attached to the Occipital Region of the Head, (length 24½ inches,) communicating with the Cavity of the Cranium, by E. S Bennett, M.D. Charleston.—*Baltimore Med. and Surg. Journ.*, vol. i. p. 351.        1833.

Observations on Sanguineous Tumors of the Head, which form spontaneously; sometimes denominated Cephalæmatoma and Abscessus Capitis Sanguineus Neonatorum, by E. Geddings, M.D. Baltimore.—*North American Archives*, vol. ii. p. 217.                    1835.

Nævi Materni, treated by needles and ligature, by George Hayward, M.D. Boston.—*Boston Med. and Surg. Journ.*, vol. xix. p. 157.                    1838.

Observations on the Nature and Treatment of Telangiectasis, or that morbid state of the Blood-vessels which gives rise to Nævus and Aneurism from Anastomosis, by John Watson, M.D. New York.—*Am. Journ. Med. Sciences*, vol. xxiv. p. 24.                    1839.

On Extirpation of Encysted and other Tumors, by Alexander H. Stevens, M.D. New York.—*Boston Med. and Surg. Journ.* vol. xxii. p. 53.                    1840.

Treatment of Vascular Nævus by Caustic Threads, by N. R. Smith, M.D. Baltimore.—*Am. Journ. Med. Sciences*, vol. vi. N. S. p. 260.                    1843.

On the Use of Collodion in the Cure of Erectile Tumors, without Operation, by Daniel Brainard, M.D. Chicago.—*Am.*

*Journ. Med. Sciences*, vol. xviii. N. S. p. 515.                    1849.

Two Cases of Morbid Erectile Tissue, treated successfully by heated needles, by J. W. Schmidt, M.D. New York.—*N. Y. Journ. of Medicine*, vol. iv. N. S. p. 66.                    1850.

Report of two Cases of Cephalæmatoma, with some Remarks on Diagnosis and Treatment, by Lewis Shanks, M.D. Tennessee.—*Ohio Med. and Surg. Journ.*, vol. ii. p 537.                    1850.

Case of Molluscum developed by an Injury, and presenting, under the Microscope, the Characters of Medullary Cancer, by Henry H. Smith, M.D. Philadelphia.—*Am. Journ. Med. Sciences*, No. xlv. N S. p. 396.                    1851.

Ulcerated Lipoma over Occiput, Removal, by L. A. Dugas, M.D. Georgia.—*South. Med and Surg. Journ.*, vol. vii. N. S. p. 271.                    1851.

Pulsating Tumor of the Occiput, by John Neill, M.D. Philadelphia.—*Am. Journ. Med. Sciences*, vol. xxvii. N. S. p. 548.                    1854.

Cancer, Treatment by Compression, Rigid Abstinence, New Surgical Instrument, Cancer Truss. by M. L. Knapp, M.D., Professor of Rush Medical College.—*N. Y. Journ. of Medicine*, vol. xiii. N. S. p. 201.                    1854.

Case of a Horn, of remarkable size, successfully removed from Head, by F. Peyre Porcher, M.D. Charleston, S. C. —*Charleston Med. Journ.*, vol. x. p. 333.                    1855.

Encysted Congenital Tumor, (on back of head,) Operation, Death, by J E. Thompson, M D. Missouri.—*St. Louis Med. and Surg. Journ.*, vol. xiv. p. 321.        1856.

Cancer of the Caruncula Lachrymalis, by C. E. Isaacs, M.D. New York.—*N. Y. Journ. of Medicine*, vol. v. 3d ser. p. 13.                    1858.

Extirpation of a large Fibrous Tumor from the Orbit, with complete restoration of vision and motion to the eyeball, by Louis T. Pim, M.D. St. Louis. (St. Louis Medical Society Reports.)—*St. Louis Med. and Surg. Journ.*, vol. xvii. p. 488.                    1859.

# PART V.

## INJURIES OF THE SOFT TISSUES.

### CONSTITUTIONAL EFFECTS OF INJURY.

The action of all the organs of the economy being regulated by the great nerve centres, the impression made upon the latter by serious injuries of even distant parts sometimes produces by reflex action a degree of functional disorder, characterized by general depression of the powers of life, that is worthy of special consideration.

During the stage of Depression, this condition is usually designated as the "Shock of Injury."

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## CHAPTER I.

### THE SHOCK OF INJURY.

In the normal or healthy condition of the body, each function is so well and accurately performed as to pass unnoticed by an ordinary observer. The moment attention is called by marked inconvenience to any one part, that moment its healthy action is changed, the duration of the disordered action varying greatly. When only interrupted for a limited period, the function may be again performed without any appreciable alteration, but when the interruption is of some hours' duration, the preservative action of life may be so impaired as to result more or less quickly in death.

When any injury of a part is of sufficient magnitude to produce a marked derangement in the function of the local nerves, reflex action may induce such a depression of the general powers of life as will result in the state technically designated as *Prostration* or *Collapse*. This depressed condition is especially noticeable in the disturbance of the ganglionic system and its effects on the circulatory apparatus, and is shown either immediately or some hours or even days after the receipt of the injury. When apparent within a short time after the injury, the condition is designated as *Immediate* or *Primary Shock*, but when not developed until several hours or days

subsequently, it is known as *Insidious* or *Secondary Shock*. In both there is a common feature of depression, the degree of which depends on the violence and extent of the injury, or the character and position of the part injured.

## SECTION I.

### PRIMARY SHOCK.

In the lighter forms of Primary Shock the patient trembles, is pale, faint, and with an anxious countenance; and much the same symptoms are said by Longmore* "to be witnessed in the horse mortally hit no less than in his rider; the graver the injury, the graver and more persistent is the shock." In marked cases the pulse is small and feeble or fluttering; the respiration somewhat oppressed and sighing; the skin pale and moist with cold perspiration; while nausea, vomiting, and hiccough are also seen, and in some cases there is often well-marked convulsions. The disorder of the nervous system varies greatly, and is sometimes rather the result of mental than of corporeal action, as in a pistol-shot in an extremity not involving important parts, but in which the patient's mind, having been impressed with the danger to which he was exposed, continues for some time subsequently to influence his corporeal functions. The violence of the symptoms of primary shock, in connection with moderate injuries, will depend often on the temperament of the patient, and his mental condition at the time. If excited by passion, quite severe injuries will often pass unnoticed, while in cool blood the very idea of a simple operation will suffice, in some persons, to produce nervous prostration of a marked character, so much so as readily to induce syncope. In gunshot wounds of the lower extremities, and in severe railroad injuries, and extensive burns, the symptoms of shock are usually most marked. In these cases the patient sometimes loses his consciousness entirely, and becomes faint, exhibiting great mental disquietude, with absence of thought, and giving foolish answers, or incoherent mutterings. The skin is covered by a cold sweat, and is pale and flabby; the muscles are all relaxed; the arm, if raised, drops as if paralyzed; the sphincters of the bladder and anus permit the escape of urine and feces, and of this the patient is unconscious. Respiration is much disordered, and barely perceptible; the pulse hardly to be felt; the action of the heart feeble, or sometimes so faint as only to be heard by applying the ear to the chest; the eyes have a vacant expression; the eyelids when raised remain open from want of action in the orbicularis palpebrarum; the jaw drops, and the hearing is temporarily lost, or is stimulated only by loud noises—the patient remaining in this semi-dead condition for a period which varies greatly, as from a few minutes to hours, according to the extent of the shock. In the milder forms, with sufficient consciousness remaining, there is only a mental commotion, so as to permit easy reassurance; but in the more marked degree this is often difficult, death sometimes supervening without reaction, though most frequently a certain amount of reaction is established and consciousness returns, or prostration again supervenes and the patient dies. When a limb is shot or torn away, or the body badly scalded, the local paralysis induced by the injury apparently prevents its immediate perception by the brain, and in numerous instances the patient has been ignorant of the loss of a limb until his attention was called to it. But as soon as the brain becomes cognizant of the injury, and the

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* On Gunshot Wounds, Phila. edit., p. 45.

stage of depression or shock sets in, these apparently distant local injuries are attended by the symptoms just enumerated, though they are seen less quickly than when the injury involves the trunk or head. When the symptoms of shock are marked, serious internal injury may be diagnosed even though not apparent at the moment. In most cases of marked shock the power of deglutition is more or less impaired for the time, while even in the milder instances the patient experiences such difficulty in swallowing as will cause, when the attempt is made, the sudden spasmodic effort designated as a "gulp," or the portion partially swallowed is ejected with symptoms of strangulation, often evidently of a hysterical character. When consciousness is not so much impaired the patient may be able to control the pharyngeal muscles, yet those of the extremities will be so imperfectly regulated as to cause the limbs to tremble as if with fright, or as if exhausted by violent exercise.

**Duration.**—The duration of the primary shock is very varied. In mild cases it disappears rapidly, the patient quickly recovering; the depression or the disposition to syncope passing away and leaving him feeble in his circulation as well as in his general strength. But in more marked cases, as in the crushing of a limb by a railroad train, or by machinery, or a round shot, the collapse lasts for several hours, when the powers of life rallying, *reaction* occurs, and there is a renewal of the ordinary functions of the nervous system, noted in the circulation, which now tends to excessive action as much above the healthy standard as the depression was below it.

This reaction after the shock of injury, if not regulated by appropriate treatment, frequently creates a *hyperæmia* or congestion of the blood-vessels, and soon develops inflammation and traumatic fever. To prevent this, and keep the reaction from exceeding its proper bounds, and yet raise the flagging powers of life, is the important indication to be accomplished in the treatment.

**Treatment of Primary Shock.**—In mild cases of shock, a few encouraging words, a mouthful of water, or wine and water, with judicious explanations of the limited extent of the injury will often suffice; but in marked cases, when the patient's consciousness is impaired, and his powers of deglutition are temporarily paralyzed or much weakened, our means of reviving the action of the system must at first be limited to such remedies as can be applied without being introduced into the mouth. The best plan of treatment is, therefore, to dash cold water on the head and face; to excite artificial respiration by gently and quickly compressing the costal cartilages, or by the "Ready Method" of Marshall Hall; by applying stimulating vapors, as strong ammonia, to the nostrils; by exciting the nerves of the skin by sinapisms applied especially to the epigastric and cardiac regions, and to the extremities; by applying heat to the surface of the body through hot bricks, bottles of hot water, etc., and by rousing the dormant action of the sympathetic nerves, through the bowels, by administering stimulating enemata, as oleum terebinthinæ, infusion of capsicum, etc., sufficiently diluted with water or mucilage to prevent the development of rectal inflammation. About ʒij of ol. terebinthinæ in a pint of soap-suds or salt water usually suffices.

When by the continued use of these remedies the patient regains sufficient consciousness to be able to swallow, or when the depression has not gone so far as that just alluded to, stimulants may be cautiously introduced into the stomach. Of these, such should be selected as are not likely to induce congestion of the cerebral vessels; hence 10 or 15 drops of the aromatic spirits of ammonia in a little water, repeated every 10 or 20 minutes, answers better than alcoholic liquors, unless the latter are given in moderate quantities, and their intoxicating tendency carefully guarded against.

As the pulse begins to respond to these measures, the use of both exter-
nal and internal stimulants should be omitted, the natural tendency being to
a reaction that must be restricted to proper limits.  Should the pulse become
full, hard, and frequent so as to indicate febrile reaction, cold drinks, cold
sponging, saline cathartics, and arterial sedatives, such as 5 drops of the
tincture of veratrum viride every hour, may be necessary — the powerful
action of the latter remedy requiring its cautious administration, so as to
repress but not depress too much the action of the circulation.   The strong
tincture of aconite root, in doses of 2 drops, or of tinct. of digitalis, in the
dose of 10 drops every two hours, for a few hours, may also be advanta-
geously used, if carefully watched and omitted as soon as the force and fre-
quency of the pulse indicate their sedative action.   By judicious attention
to the proper action of the circulation in these cases, carefully stimulating
the patient when in the collapsed or depressed condition, and inducing seda-
tion when the reaction becomes excessive, patients may be rallied from the
shock of injury and subsequently treated as demanded by the peculiar nature
of the case.   In that mild degree of shock, sometimes seen in patients who
have been shot by a bullet in the extremities, or struck on the testicles or in the
pit of the stomach, which is characterized by faintness, trembling, and mental
anxiety, a little cold water, or wine and water, with a few words of hope as
to the result of the injury, often suffices.

## SECTION II.

### SECONDARY OR INSIDIOUS SHOCK.

In many severe injuries, and especially in those which involve the main
trunks of large nerves, or the spinal cord, or a great extent of the surface
of the body, there is sometimes noted, at varying periods after the recep-
tion of the injury, a train of symptoms of a marked character, that are very
justly spoken of as those of the secondary or insidious shock of injury.

**Symptoms.**—The symptoms of insidious shock are often so masked as to
escape the attention of an inexperienced observer, until they are so far de-
veloped as to render it difficult to rally the forces of the patient.   Thus
when a limb has been torn off by a cannon-ball, or in a rolling-mill, or a
thrashing-machine, or by a railroad train, the patient not unfrequently appears
to be almost unconscious of the severity of his injury, the local paralysis
being so perfect as to prevent the excruciating suffering that such an injury
would otherwise create.   In the case of the railroad accident, by the collision
of opposing trains on one of our railroads, I saw a young man who had his
arm cut off near the shoulder-joint, with so little suffering as to be unaware
of the extent of the injury till his clothing was removed.   By great care he
subsequently recovered.

In numerous instances in the experience of all surgeons, such patients
have presented the following symptoms: immediately after the injury they
are remarkably cool, self-possessed, and as if endowed with indomitable for-
titude; the pulse is often barely accelerated; the respiration quiet and
natural; the skin pleasantly warm; the mind clear, though perhaps a little
torpid, but apparently with perfect consciousness.   In some cases patients
have been known to walk or ride some distance, evidently unconscious of
injury, till suddenly faintness supervenes, and they fall to the ground, and die
in the course of an hour, more or less.   In other cases, where the external
wound or injury is more evident, they will give directions for their removal,
arrange their bed, business, etc.; reply to questions rationally, and with great

composure; yet, as has been well described by the late Dr. George McClellan,* they will present a countenance that is altogether unnatural, having "an inquiring, anxious look about the forehead, eyes, and upper portions of the face, while all about the mouth is smiling and composed." In addition to which "they look with a stare of alarm and suspicion at the surgeon when his attention is called to them."

After this period of treacherous calmness has existed from three to eighteen hours, the expression suddenly changes; the lips become livid or deadly pale; the blood leaves the surface of the body; the pulse flutters and becomes too rapid to count; the respiration is short and panting; a great sense of oppression distresses the patient, and he sinks slowly, as if suffocated, or dies as if struck down by lightning. In these cases the foundations of life are undermined, and the paralysis, which was at first limited to the part injured, suddenly extends to the nervous centres, and life is arrested by the want of proper nervous force.

**Prognosis.**—The prognosis in cases of severe injury, in which the patient is thus unconscious of suffering, cannot be too guarded, the patient not being out of danger from insidious shock until after the lapse of forty-eight hours of perfect tranquillity. In the majority of such cases when secondary shock supervenes, death ensues.

**Treatment.**—The treatment of secondary or insidious shock should be chiefly prophylactic, special attention being given to the preservation of the powers of the nervous system by the administration of food and stimulants, while all muscular action on the part of the patient should be carefully guarded against.

In many cases it will be useful to give milk-punch, beef-tea, quinine, carbonate of ammonia, chalybeates, etc. as often as possible, until some evidence is shown of their effect upon the circulation. Then, while the patient is strictly confined to the recumbent position, stimulating frictions should be made along the spine, cold applied to the head if it becomes hot, pediluvia or hot bottles applied to the feet if cold, and access given to a sufficient amount of fresh air in the chamber to favor active respiration, while the patient is at the same time kept warmly covered up in bed. By such means the occurrence of secondary shock may be prevented; but should it supervene, nothing but powerful stimulants to the spine, or the administration of ether, brandy, tincture of capsicum, etc., with the free use of beef essence, affords a hope of checking the rapid prostration that, if not watched, will carry off the patient. In every case of serious laceration of a limb, opening a large joint, tearing nerves, etc., cautious watching of the pulse can alone guard against the development of insidious shock. If the patient is disposed to sleep, let the pulse be noted, and let him be awakened every hour to take nourishment, if the pulse begins to flag. As the symptoms of shock are usually the result of serious and extended injury, the question of the propriety of operating for the relief of the injured part will often arise. Unless in the case of the laceration of blood-vessels from which the blood oozes, the opinion of most surgeons is adverse to the propriety of operating until *reaction* is fully established; and since unconsciousness can be readily induced by the use of anæsthetics, the supposed advantages derivable from amputating a limb while the patient was unconscious of the injury, are generally regarded as evidence of a want of judgment on the part of the operator. How soon after reaction an amputation should be performed, will depend on circum-

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* Principles and Practice of Surgery, p. 18. Phila., 1848. Edited by Dr. Jno. H. B. McClellan

stances, and be again alluded to when speaking of the advantages of primary over secondary amputations.

Occasionally it happens that after reaction is established and traumatic fever supervenes, the patient becomes delirious, or traumatic delirium or wandering, without fever, is met with. If this delirium is an attendant on the febrile condition, sedatives, cooling applications, and the judicious use of opiates, with antiphlogistic remedies, as antimony, arterial sedatives, and such others as are adapted to inflammatory fever, will be required; in other cases opiates are mainly sufficient. Should delirium tremens supervene, the usual treatment, as described in treatises on the practice of medicine, with great attention to the seat of injury, will be requisite. Among high livers or in the intemperate, a comparatively slight injury will often induce an attack of delirium tremens, requiring opiates and stimulants to counteract it, or, if the pulse is exceedingly frequent without prostration, the administration of large doses of the tincture of digitalis or veratrum viride. In delirium tremens supervening on pistol wounds, in many of our volunteer soldiers in camp for the first time and deprived of their habitual drams, I have seen marked benefit derived from the administration of half an ounce of the tincture of digitalis every four hours until three doses are taken, this apparently heroic treatment sometimes inducing a perfect cure in thirty-six hours. As the dose advised is very large, the pulse should be cautiously watched before it is repeated.

# CHAPTER II.

### REPAIR OF INJURIES IN THE SOFT TISSUES.

It has been already shown, in connection with the organization and development of lymph as the result of inflammatory action, that as the development of fibrin progressed it became vascular, and finally approximated in its character the tissue on which it was collected, though this approximation was seldom so close that the difference between the newly-formed and original structures could be detected. In fact, none of the tissues or organs of the body can lose any appreciable portion without the loss being subsequently more or less evident. That the varied cell action in the tissues at the seat of injury is the basis of this difference, is generally admitted, though this is modified, and the result most marked, in cases in which the atmosphere has access to the injured structure during the process of repair. The effect of the atmosphere in these cases was early noticed by surgeons, and attracted the special attention of Mr. John Hunter, who laid down the general principle that injuries of tissues that do not communicate with the atmosphere seldom inflame, or do so to a very limited extent; while those which do, take on a degree of inflammatory action that is apt to run on to suppuration, or even to some more destructive stage of inflammation. In the first case the repair is prompt and certain, while in the second it is tedious and liable to failure. Various instances might be cited in corroboration of the correctness of this assertion, such as the rapid healing of the tendo-Achillis when divided subcutaneously in the treatment of club-foot, union of the divided edges being then accomplished in forty-eight hours, while in an open wound the healing process would be very slow, and in extensive injury, doubtful. The same thing is noted in the repair of fractures, the process of union being much more rapid in a simple fracture where there is no wound, than in a compound

one where the atmosphere has access to the bone.   In analyzing this result, it must be borne in mind that heat and moisture are necessary for the development of every animal or vegetable structure, the growth of each being checked or promoted in accordance with these circumstances.   Change of temperature—dryness and chemical action are the result of the contact of the atmosphere with a healing surface in open wounds, and this depresses and ultimately paralyzes to a certain extent that cell action which is essential to the formation of the connective tissue that constitutes the foundation of the new structure.   The importance then, in all wounds, of excluding the atmosphere, and thus avoiding the effects of the chemical elements that enter into its composition, as well as of counteracting the effect of evaporation, cannot be too highly estimated.

The cicatrix or inodular tissue, formed in the repair of the injuries of the different structures that compose the body, is chiefly connective or fibro-cellular tissue, varying somewhat in certain cases, as in the repair of the nerves. In the *skin* the organized lymph results in a structure that we recognize as the *scar* of common language, the organic action by which it is formed being termed cicatrization.   Cicatrization is the process of repair, the cicatrix the material by which lost or divided parts are repaired.   After wounds of the skin, mucous membranes, blood-vessels, tendons, and muscles, the lost tissue is replaced by one similar to, yet not precisely like normal tissue.   In most instances the cicatrices or homeoplastic textures produced by inflammatory action "are composed of areolar tissue, a fibre analogous to that of organic muscle, transition cartilage, bone, nerve, and blood-vessels.   The regeneration of nerve fibrils after wounds attended with loss of substance does not take place as a new formation out of the lymph, but as a growth of nerve from its cut ends into the lymph constituting the provisional cicatrix."*

When a cicatrix is recently formed and carefully examined it seems to be composed, according to the best observers, of fibro-cellular or connective tissue, with which at a late period elastic tissue is mingled, abundant blood-vessels running through it in a direction chiefly parallel to the filaments, the free surface being covered with an epithelium similar to that of the tissue in which it is found.†

The amount of elastic tissue varies somewhat, according to the tissue in which the cicatrix is found as well as the character of the injury repaired by it.   In burns it is especially marked, and the effect of its presence is to be noted in the continued contraction of inodular tissue and the varied changes cicatrices undergo.   These changes are a diminution in length as well as in the breadth of the cicatrix, which grows smaller as time progresses, while its diminished size is accompanied by a diminished color and loss of circulation, an old cicatrix in the skin being ultimately whiter than the normal tissue, though at first its vascularity was so much greater, and its epithelial covering so much more delicate than the cuticle, as to make it distinct by its redness.   The change of vascularity in cicatrices may also be observed, as compared with that of normal skin in the disposition of those of old ulcers and wounds, to die and be thrown off in such disorders of the general powers of life as are seen in scurvy, etc.   The tendency of inodular tissue to contract will be again referred to in the healing of Burns.

It has been already shown, in connection with the development of lymph and the formation of granulations, that a certain amount of heat and moisture favored its organization and the reparative effort.   We shall hereafter see

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* Rokitansky, vol. i. p. 166.   Sydenham translation.
† Paget, Lectures on Pathology.

that an excessive degree of heat or cold, whether with or without moisture, but especially with it, will check reparative action and create a destruction of tissue that may eventuate in its death and separation from the living parts, under the inflammatory process, or even make such an impression on the general powers of life as will destroy the patient, as will be shown under the general head of Burns and Frost-bite.

In the repair of the injuries of the soft tissues ensuing on wounds there are three principal methods by which union and the reproduction of lost tissue may be accomplished.

The first is that by "immediate union," or the first intention of McCartney.

The second, "union by adhesive inflammation."

The third, "union by the second intention," or by granulation.

To this some writers have added another under the head of "the scabbing process."

Union by the first intention of McCartney, that by adhesive inflammation, and that by granulation having been already explained under the head of Organization of Fibrin, page 218, the scabbing process, or that in which the injury produced by wounds is repaired under the protection of a scab or crust, becomes the present subject of attention.

Healing of wounds by the scabbing process at one time attracted notice, and was supposed to be an extremely desirable mode of union, so much so that in the case of certain wounds, and especially those which communicated with closed cavities, the creation of an artificial scab, or one made by dusting some dry powder over the wound, applying dry lint, or covering it with the white of egg or collodion and permitting it to dry, was deemed highly useful. While it is admitted that this scabbing process may, in some instances, prove beneficial, yet in many it is objectionable. If the scab is sufficiently complete to exclude the air, which is one benefit supposed to be obtained from its use, and the wound is of any size, the discharges will be retained—be liable to burrow—to become acrid, and to retard the process of granulation; while if it is not perfect enough to produce this effect, it admits the atmosphere, and the benefits claimed as peculiar to its use cannot possibly be obtained.

Another mode by which wounds heal is by that designated as the "modeling process," which, being the result of the production and organization of lymph, is really only a modification of the ordinary union by granulation, and does not appear to be deserving of special consideration.

With regard to the comparative value of the other two processes of repair in wounds, that is, "union by adhesion" and "union by granulation," there is a diversity of sentiment. Generally it is deemed sound practice to seek for union by the first intention or by adhesive inflammation in every wound, as it is the safest and most rapid mode of cure, while if it fails, it does not in any way retard the subsequent union by granulation.

As the production of wounds was attended by hemorrhage, the question soon arose among surgeons whether effused blood was employed by nature as a bond of union, and was essential to the reparative process, or whether it did not retard the cure. As all wounds gave rise to an effusion of blood, and this was considered as "the life of the creature," the earlier surgeons believed that the blood was useful, and never removed a clot from the wound, but rather encouraged its formation in all instances. Even as late as the time of Hunter this opinion was generally maintained, and was subsequently supported by the experiments of Sir Everard Home, Carswell, and McCartney, they supposing the clot to be useful because it contained fibrin, which they believed capable of organization, as they had succeeded in injecting a clot.

Minute examination also confirmed the fact that a blood-clot "might become organized and even assume the character of a tissue, coalesce with adjacent parts and become vascular," as was shown in 1845 by the experiments of Zwicky. In 1848 Paget had an opportunity of confirming Zwicky's account of this organization in a clot obtained from the arachnoid of an insane person, where a thin layer of a pale ruddy membrane lined the whole internal surface of the dura mater, and adhered to it, while its color, etc. proved satisfactorily that it had been a thin clot of blood effused in apoplexy. "Numerous small vessels could also be seen passing from the dura mater into this clot membrane, and while they were still full of blood, Paget made the sketch shown in Fig. 186.

"The minute structure of this clot, as shown in Fig. 187, bears a strong

Fig. 186.
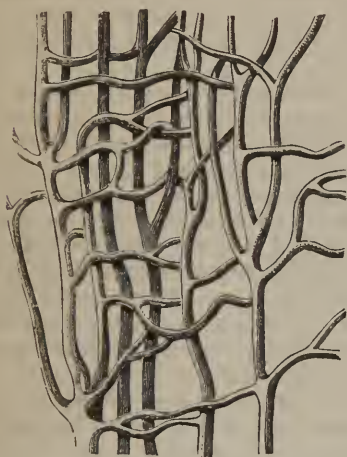
Fig 187.



A microscopic sketch of the Vessels of a Blood-clot as made by Paget. (After Paget.)

A microscopic view of the Structure of the Injected Blood-clot. (After Paget

resemblance in its general structure to the characters seen in the material formed for the repair of subcutaneous injuries, as in the substance of what appeared like a filamentous clot of fibrin sprinkled over with minute molecules, the addition of acetic acid brought into view corpuscles like nuclei or cells, very elongated, attenuated, and, in some instances, like short strips of flat fibres."* Notwithstanding these appearances, so analogous to the reparative process in fibrin, Paget, however, became satisfied "that extravasated blood had usually *no share* in the repair of wounds; as the smallest portion of blood was effused in cases where the largest amount of reparative material was produced in the shortest time. He therefore decided that extravasated blood was not necessary for union by the first intention, though the lymph around it became organized."†

After showing how the blood-clot was removed from a wound by ejection, and how it is absorbed as unnecessary, Paget states the following as his conclusion, an opinion in which every experienced surgeon will doubtless now coincide.

"1. Blood is neither necessary nor advantageous to any mode of repair.

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* Op. citat., p. 121.                     † Ibid., p. 122.

"2. A large clot, if at all exposed to the air, irritates the part, and is ultimately ejected.

"3. In more favorable conditions, the effused blood becomes inclosed in the accumulating plasma, and, while this is organizing, the blood is absorbed.

"4. It is probable that the blood may become organized and form part of the reparative material; but even in this case it probably retards the healing of the injury."*

As the blood-clot thus retards the healing of wounds, it might be deemed advantageous to keep the wound open until all hemorrhage had ceased, and the clots could be removed; but this is not so, it being sound practice to close a wound as soon as possible, as this prevents further hemorrhage, if from numerous small points, by direct contact of its sides under gentle pressure.

To illustrate the importance of promptly closing wounds in which the process of repair is to be obtained by adhesion, as well as its success under the most unfavorable circumstances, the following cases are cited from the work of Thompson :—†

When Pharavant, a surgeon of the sixteenth century, was in Africa, "there happened," says he, "a very strange affair; a certain gentleman, a Spaniard, called Gutiers, of the age of twenty-nine years, upon a time walked in the field and fell at words with a soldier, and began to draw; the soldier seeing that, struck him with the left hand and cut off his nose, and there it fell down in the sand.  I then happening to stand by, took it up and pissed thereon to wash away the sand, and dressed it with our balsamico artificiato, and bound it up, and so left it to remain eight or ten days, thinking that it would have come to matter.  Nevertheless, when I did unbind it I found it fast conglutinated, and then I dressed it only once more, and he was perfectly whole, so that all Naples did wonder thereat, as is well known, for the said Signor Andreas doth live, and can mention the same."

Bleigny also mentions a case in which, after the nose had been cut off for some time, it was applied, and perfect union resulted; and Balfour records one in which a finger, being chopped off in a carpenter's shop, in cold weather, fell down among the shavings and remained some time; yet afterward, being taken up, washed in warm wine and reapplied, perfect union occurred.

Duhamel and Hunter also performed numerous experiments on this subject, by successfully transplanting the spur of a cock to his comb, and the teeth of one individual into the mouth of another, etc.

In the latter cases, though union doubtless occurred, yet it was not the result of a true adhesive process, but rather due to the effusion of lymph around the transplanted bodies and the prolongation of blood-vessels through it from the healthy tissues.

These facts, however, certainly show that, even when the separation of divided parts has existed some time, the surgeon should attempt, in case of the cutting off of small portions of the body, to replace them, particularly if they are such that great deformity or inconvenience will result from the loss.  The experiment may often fail, but it will also sometimes succeed, and the result justifies a trial.

The process of repair in wounds by means of granulation and cicatrization having been already described under the head of Inflammation, need not now be again referred to, while the sutures, before described,‡ are mainly useful in the treatment of wounds  In the repair of all injuries of the soft

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* Op. citat., p. 124.        † Thompson on Inflammation.        ‡ Page 196.

tissues it is important to recollect that fresh fibrin will not be formed, or, if formed, its development will be checked by inflammation ensuing or continuing in the part, this producing a congestion of the blood-vessels that materially impairs the tissue cell action of the structure, which is in most cases repaired by a process nearly identical with normal nutrition and development, as seen during "the period of growth."

# CHAPTER III.

## BURNS.

BURNS, or the changes of vital action created by the application of an unnatural degree of heat, or one greater than the highest temperature of the blood, present injuries that are usually studied under one head — though there are two modes in which they may be produced—one by the application of hot solids, the other of hot liquids. The first are strictly classified as **Burns,** the latter as **Scalds,** though the first term not unfrequently is employed to designate the injury from both causes.

When a high degree of heat is applied to a tissue, the result indicates a loss of the vital action, that varies in proportion to the depth and extent of the portion injured. In the slightest form there is simply increased vascularity and a superficial inflammation; but in a more marked degree, there is such a perversion of the local nutritive action as results in its more or less perfect destruction, the general powers of life being affected in proportion to the depth and extent of the injury.

As a general rule, it may be stated that fire or heated solids produce a more serious class of injuries than heated liquids, while the former are the most circumscribed though the deepest, hot liquids rapidly passing over the tissues, unless kept in contact with them by the saturated clothing. Thus, if the skin be touched with a red-hot iron, or if the clothing takes fire, the heat is often sufficiently long in contact with the part to destroy it deeply, while hot water flows off quickly. A viscid liquid, as hot oil, etc., will, however, often create as deep an injury as fire itself.

The *danger* to life arising from severe burns is the result of that general relation of one part of the body to all others that has been already alluded to under the head of Constitutional Effects of Injury. They may be classified under four heads :—

1. The *shock* or depression of the nervous system.

2. The *reaction* or excessive action of the vascular system.

3. Internal disorder, as of the mucous membrane of the bowels, etc., from the modified action of the superficial tissues.

4. The febrile action consequent on the reparative effort, as well as the evils resulting from the healing process.

**Varieties.**—Burns have been well classified by Dupuytren, for the purpose of study, into six classes, though this accurate division is not to be found in nature, a deep burn sometimes presenting the sixth degree at one point and the first at another; yet is this classification highly useful to the student. It is as follows :—

I. Burns which create merely superficial redness or inflammation, but without the exudation of serum or vesication. Here a simple erythema or turgescence of the vessels is the ordinary result.

II. Those in which the inflammation goes still further, and results in the effusion of serum, the cuticle being elevated into blisters, constituting the condition ordinarily known as vesication.

III. Those in which the heat is applied in a still higher degree, or for a greater length of time, thus producing not only redness and vesication, but also the destruction of the derm or true skin.

IV. Burns in which not only the cuticle and skin, but the subcutaneous areolar tissue is converted into an eschar.

V. Burns which are attended by the destruction of the subjacent tissues, muscles, etc.

VI. Those in which the entire structure is carbonized or burned to a cinder.

In the first class we have simply the symptoms of inflammation in its first stage, or that of congestion, which have been already described. In the second, we have the effusion of serum and a superficial raw surface, resulting from the rupture of the bullæ, this superficial sore or abrasion being similar to that produced by a fly-blister. In the third may be noted instances of limited gangrene, the dead parts being separated by the process of sloughing. In the fourth class the vital structures are encroached upon to a greater depth; and the fifth and sixth furnish examples of true sphacelus, which, when limited in extent, is usually spoken of as an "eschar."

**Seat.**—Burns may be found in any situation, but they are very often seen upon the back, especially in females, as in consequence of the skirt of the dress coming in contact with the fire, the flames rise, and, before they can be extinguished, produce a burn of an extensive character. The same accident happens at times to children, though in these little patients it is usually the front of the dress that is set on fire, there being a corresponding change in the locality of the burn, which is thus apt to reach the front of the neck and the face.

**Symptoms.**—The local and general symptoms of burns differ according to their extent. The most marked of the local symptoms is usually pain, unless the skin is entirely destroyed, and then there is little or none, until the inflammatory action is induced in the surrounding parts to a sufficient extent to produce it. The most serious of the general symptoms are those due to the shock, these being generally shown in depression or chill, followed by reaction and fever, with the modifications of pulse and of secretion which have been already described under the head of Irritative Fever.

**Diagnosis.**—The diagnosis of burns sometimes becomes of great importance in a legal point of view, as the surgeon may be called upon to say whether the injury has been the result of a scald or a burn, as where a woman has sworn that she has been pushed into the fire by her husband, but where the character of the injury proves that it was not due to a burn but to a scald. The establishing of this fact would, in most cases, be sufficient to vitiate the action; and it becomes, therefore, a matter of consequence to recognize positively the difference between scalds and burns.

As a general rule, a burn may be told from a scald by its limited character and by its depth, though the latter difference is not always marked. A very good rule, and one which will apply to most doubtful cases, is this: if the hair is singed we may pretty safely assert that the injury in question was a burn, as in scalds the hair is most generally left, or is not removed unless the cuticle has been removed with it; but even then the hair of adjacent parts will indicate the character of the injury. Great caution should, however, be observed by every surgeon in giving an opinion under such circumstances.

**Prognosis.**—The prognosis of burns will be governed by the extent, by

the degree, and by the character of the portion burned: thus a burn near the eye or near the mouth would be much more serious in its consequences than a burn upon one of the extremities. The age and habits of the patient will also materially affect the prognosis, as a young person will bear a serious burn better than one enfeebled by years, and a temperate person will be less likely to succumb than one of intemperate habits. Certain circumstances will, however, materially influence the prognosis even under these conditions, as the fact of the patient being under the influence of alcohol at the time of the injury, by which the sensibilities were blunted, as was once presented to me in the case of a man who, having sat down while drunk near a stove, fell with his knees against it, and did not awake till they were literally roasted through. This man, however, recovered after an amputation of both limbs, having apparently been unaffected by the excitement and suffering on the reception of the burn, which would otherwise probably have been sufficient to destroy his life.

With regard to a special prognosis, it may be stated that, as a general rule, the experience of all surgeons agrees with that of Dupuytren, "that a burn of the first or second class covering *one-half* the body will be likely to prove fatal; that one of the *third* class occupying *one-fourth* of the body will most likely terminate in the same manner; while the fourth, fifth, and sixth classes will be apt to produce death if only one square foot of the body be affected."

**Treatment.**—The local and general treatment of burns varies with the extent of the injury. In superficial burns, where there is simply redness, and the ordinary signs of commencing inflammation, the indication is first to diminish the sensibility and check the vascular action of the parts. No application is likely to prove of greater service in carrying out these indications than that of cold water, applied to the part by means of irrigation. It is, indeed, a very natural thing after burning a finger to put it into cold water, with a view of allaying the pain, and, as both cold and moisture have a sedative effect, no better plan of treatment can be pursued. If the burn is of a very limited extent, a bladder may be filled with cold water or pounded ice, and laid upon the parts; but it should not be filled too full, or its weight will make it painful, but only half filled, so that it may lay over the surface and keep up a moderate degree of coldness; or lint may be wet and applied to the burn, as in irrigation. To the cold and moisture of the water-dressing we may also add some sedative article, as the watery extract of opium. Ink and the domestic application of scraped potatoes, etc. are chiefly useful as means of applying cold. The sugar of lead, Goulard's extract, or some other mild astringent, may often be advantageously added to the water-dressing. In the case of burns of the second class, or those in which the cuticle has been more or less vesicated, it will sometimes prove useful, with a view of shielding the skin, and doing away with the irritation likely to be produced by the contact with the atmosphere, to resort to raw cotton, carded and laid on the part; or to the Linimentum Aq. Calcis of the United States Pharmacopœia, or Carron oil, as it has been called, because originally extensively used and kept constantly on hand at the Carron Iron Works in England. This liniment consists of equal parts of linseed oil and lime-water, and should be spread upon rags and laid over the parts. It has, however, one objection, and that is, its very disagreeable smell, which, to most persons, is exceedingly offensive. Glycerin has also been recommended, and is to be used in the same way. As it is a very mild, unirritating substance when pure, it will, in many cases of superficial burn, prove useful.

With the same view—that of excluding the atmospheric air—it has been recommended to dust flour over the parts, and this is sometimes highly ser-

viceable, although it is not applicable to that large class of burns which result in suppuration, as in these cases the pus, mixing with the flour, cakes it, and the whole drying, more or less sharp, irregular masses are produced, which lacerate the injured surface upon every movement of the limb, and develop a very considerable amount of inflammation. It is, therefore, a dressing which is specially applicable only to very superficial burns. Other articles of a similar character have been recommended at different times, and may be noticed, in order to present a list of such as may be obtained when others cannot. Thus chalk, finely powdered and dusted like flour over the part, is sometimes useful. White-lead, ground with linseed oil, as in the ordinary white paint, has also been highly recommended by Barry, in England, and by Prof. Gross, of Philadelphia; the lead being ground in the oil and spread thinly over the surface, so as to give it a complete coat of paint. If the burn is of a very limited extent, the surface may sometimes be very advantageously painted with collodion or the ethereal solution of gun-cotton. This is at first painful, from the stimulus of the ether which the preparation contains, but as the latter soon evaporates, the collodion shields the parts from contact with the atmosphere, produces contraction of the tissues, and thus promotes the healing of the ulcer while obviating external sources of irritation.

Liquid caoutchouc has been highly recommended by Stillman, of New York.* This milk of the hevea or caoutchouc, in the liquid form in which it exudes from the tree, preserved in that state by the addition of a small proportion of free ammonia, and now introduced as an article of commerce for manufacturing purposes, is of the color and consistency of pure milk, but becomes transparent. Owing to its great elasticity it does not contract so violently as the collodion, adheres closely to the skin, and allows of entire freedom of motion and application to any extent. In burns, Stillman thinks it has an advantage over anything he has ever used.

In the superficial burns resulting from the accidental explosion of gunpowder, grains of powder unconsumed are often buried in the skin, and leave subsequently a blue point, which creates deformity. To remove it, Busch recommends the application to the part of a solution of corrosive sublimate, five grains to the ounce, so as to create an eczematous eruption, the vesicles of which will contain the grains of powder, which will fall off with the dried scales resulting from the vesicles.

In the more severe forms of burns, where there is a disposition toward sloughing, as it is always desirable to favor the early separation of the slough, there is nothing better than the warm water-dressing, applied from the very first moment, and continued throughout the treatment as long as heat and moisture can be beneficial. One great recommendation of this dressing is its cleanliness, the constant flow of water washing away the pus before it can be decomposed, thus securing the purity of the air of the chamber, and removing one great source of annoyance in these accidents The old method of burying the patient in poultices is objectionable, because they are heavy, liable to become rancid, to interfere with cleanliness, to adhere to the diseased surface, and to act as receptacles for the very free discharge of pus, which generally ensues upon a burn, and which soon becomes offensive from its decomposition. Patent lint, saturated with warm water, as in the warm water-dressing already described, gives moisture and heat in a much neater form, and does not oppress the patient. As soon as the slough seems disposed to separate, it will be useful to stimulate the action of the parts so as to favor the cicatrization, evidences of a want of action being generally

present in the granulations of the ulcer which remains after a burn. A very good application for this purpose is the Kentish ointment, made, as already mentioned, of turpentine and basilicon ointment. This ointment was applied by Kentish, of England, to all classes of burns, but is especially useful in those which are deeply burned, as it stimulates the local circulation and resuscitates the vital powers of the part. When it cannot be obtained, its place may be temporarily supplied with the fermenting poultices or similar stimulating applications.

A very important part of the treatment of burns is the management of the ulcer which is left after the separation of the eschar or slough. This is frequently very difficult to heal, and presents the characters of the ordinary irritable ulcer. In order to favor its cicatrization, sedatives will often prove useful, such as the cold water-dressing, which is very soothing, and, by washing away the pus from suppurating burns, keeps off one source of irritation. Sometimes, in the ulcerated stage of burns, stimulating applications are demanded, in order to excite reparative efforts and overcome the local depression consequent on the injury, such as touching the edges of the ulcer with a stick of nitrate of silver, stimulating the parts and inviting the scabbing process, by dusting the surface of the ulcer with finely-pulverized calamine or prepared chalk, and then covering it with a piece of spread cerate and oiled silk, so as to exclude the air. In some cases of long-continued ulceration, consequent on burns of the back, I have derived benefit from powdering over the entire surface the precipitated carbonate of iron, and covering it with a dressing of dry lint, renewing it every twenty-four hours. Under this the dressing granulations acquired a more healthy character, and cicatrization progressed.

Fig. 188.
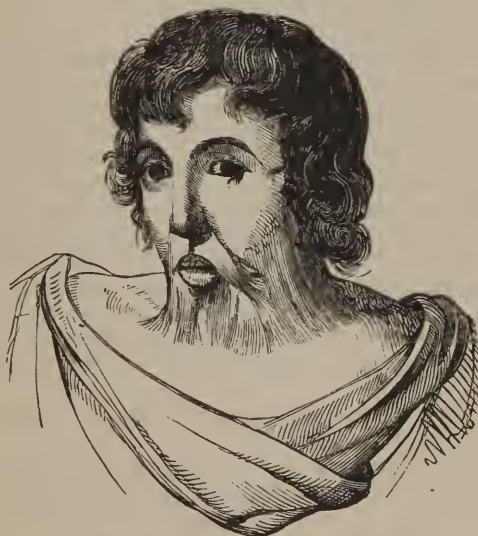


A representation of the Deformity caused by the Contraction of the Cicatrix of a Burn on the neck. (After Liston.)

The **cicatrix** from burns is often a source of serious difficulty, as it has a greater tendency to contract than any other cicatrix or inodular tissue resulting from injury. So marked is this tendency in some cases, that the

motion of limbs is lost, and surrounding parts are drawn out of their line, so as to create great and striking deformities. Generally this contraction shows itself by the influence which it exercises in the traction made upon surrounding tissues, rather than in the substance of the inodular tissue itself, the adjacent skin being very much puckered, and presenting ridges, furrows, seams, and all other varieties of disfiguration, Fig. 188. Sometimes, also, the cicatrix presents such a low degree of vitality that ulceration is constantly taking place in it. The relief afforded by the division of any of these cicatrices is exceedingly doubtful, and, as a general rule, it may be said that it is useless to cut through any adhesions which result from burns, unless a plastic operation is also performed in order to replace the tissue that has been destroyed. Thus, for instance, in an adhesion of the arm to the side resulting from a burn, it is worse than folly to cut through the cicatrized portion in order to free the limb. If the arm be tied up over the head, so as to prevent the possibility of any contraction, the ulcer will not heal; and if we let it down to heal the ulcer, the contraction will be reproduced. The same is true of adhesions between the fingers; unless we can introduce a portion of new skin by a plastic operation, it is useless simply to divide the cicatrix. It is necessary, therefore, to watch burns when first healing, in order to prevent these adhesions as much as possible, and particularly in the case of those situated near orifices, such as the mouth, the nostrils, the anus, or the vagina, where it is particularly desirable the patulous condition of the parts should be maintained; the same precautions will be required in burns near joints on the fingers and toes.

**Pathology of the Cicatrices from Burns.**—Delpech having shown that in all wounds which suppurated freely, or did not unite by the first intention, the granulations resulted in the formation of a fibrous tissue unlike the ordinary structure of the part, which structure he named the "Inodular," all cicatrices, and especially those resulting from burns, are often spoken of simply as "Inodular Tissue."

This tissue is always the result of suppurative inflammation, is manifestly fibrous in its character, of a dull, white color, without the shining appearance of fascia or the satin-like character of the surface of a tendon. In consistence and hardness it has been compared to the strongest ligaments of the joints; but its fibres, unlike these ligaments, run in all directions.[*] The contraction of this structure, although at first highly useful in closing any wound, may, by its continuance, create such traction upon surrounding parts as will result in the evils just referred to; and, as it continues to contract for various periods after its formation, Dupuytren established three rules of practical value in the selection of such cases as could be relieved by a surgical operation.

1. He advises the surgeon not to attempt to correct the deformity resulting from these cicatrices, until many months, or even years, have elapsed after their production.

2. Never to operate unless certain of obtaining a larger cicatrix than that which it is wished to correct.

3. To be certain that the operation can restore the parts to their shape; consequently, in cases of anchylosis of a joint, the operation would be improper.

In relation to the different modes of operating, he also gives directions of much value.

1. In a long, narrow cicatrix, he recommends the operator to make several incisions so as to divide the cicatrix transversely through its entire

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[*] Dict. de Med., vol. vii. p. 579, et infra.

thickness, without ever removing any part of it, in order to facilitate its stretching.

2. To stretch the parts, and bring them into a direction different from that which the complaint had caused, in order to obtain a cicatrix by the production of new skin. This extension must, however, be practiced with judgment, lest violent pain, inflammation, and gangrene result, as in a case reported by Delpech.

In salient cicatrices, unaccompanied with retraction, he advises:—

1. To remove the prominence by a subcutaneous section, the knife being introduced flatwise, and made to shave the skin from the cicatrix as far as its extremities, in order to loosen the latter.

2. To keep the edges of the wound open.

3. Frequently to cauterize the surface, so as to keep it a little below the level of the integuments.

Delpech, on the contrary, advocates the removal, as far as possible, of the entire cicatrix, and says that, when this is done, there will generally be found sufficient skin to draw upon, in a direction opposite to that which caused the deformity, thus enabling the operator to obtain immediate re-union.

When it is possible to gain sufficient skin to permit this immediate reunion of parts, the method of Delpech will be found preferable; but, in other cases, a large gaping wound would be formed, which would create even greater trouble than the original complaint.

The decision of either operation will, therefore, necessarily depend chiefly upon the peculiarities of the case presented to each operator at the moment.

In extensive cicatrices about the neck, where it is of great consequence to obtain free motion, without being liable to a modified reproduction of the difficulty from the newly-made cicatrices, some of the various autoplastic operations will prove specially serviceable.* In these operations, the ordinary principles of plastic surgery must be followed out, and the flap, which should if possible be taken from a part of the skin where it is healthy, made of such a size as may be demanded to fill up the wound left by dissecting out the cicatrix, or by destroying its adhesions. This flap, allowance being made for its contraction, should be closely attached to the edges of the wound by numerous points of the interrupted metallic suture.

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* See Plastic Operations on the Face, vol. ii.

# CHAPTER IV.

## EFFECTS OF COLD.

When cold is first applied to the body in a moderate degree, its effects are those of a gentle and pleasant stimulant. Carry it a little further, and the stimulation becomes painful, producing an aching, tingling pain. Carry it yet further, and the depression which always ensues upon superexcitement is developed in the part, which now becomes numb and devoid of sensibility. Carry it further still, and there will be a depression of the vital powers both in the heart and nervous system, from which the patient may not recover.

When the sedation produced by cold, as applied to the entire body, is brought to such a degree as to impair materially the function of the nerve centres, we have the constitutional symptoms which result from congestion of the brain. Thus the patient will have a marked disposition to sleep, or at times exhibit tetanic spasms, as was the case in some of those exposed to Polar cold in the expedition of Dr. Kane, after the loss of the vessels. More frequently, however, stupefaction and coma supervene on the exposure, the patient sinking quietly and unconsciously into the sleep of death.

The effects of cold upon a limited portion of the surface of the body may be classified under two distinct heads, both being evidently due to inflammatory action, resulting from the reaction consequent on local or general sedation, and both presenting, therefore, only a certain degree of inflammation, produced, it is true, by a specific cause, and yet in all respects amenable to the general principles already stated in connection with inflammation. To the slighter form of irritation thus induced, the name of **Pernio** or **Chilblain** is given, this indicating a condition resulting from the stimulus of cold that creates a modified circulation and change of sensation in the skin; while the second or more marked degree, or that of the depression supervening on stimulus, and resulting in the production of gangrene, is designated as **Frost-bite.**

Those portions of the body which possess the least vitality are those most apt to suffer from the depressing effects of severe cold, and accordingly we find chilblains and frost-bite generally appear in the tips of the nose or ears, or of the fingers and toes.

## SECTION I.

### PERNIO OR CHILBLAIN.

In **Pernio** or **Chilblain**, or that superficial irritation which is developed in parts exposed to cold, we have the following symptoms :—

**Symptoms.**—In the first place, there is a tingling or a benumbing sensation, which is much augmented, and gives rise to the burning sensation with which most persons are familiar, when the extremities, after exposure to cold, are

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brought near to a fire. The part then also assumes a violet or livid color, this depending for its intensity upon the degree of cold which has been applied, after which reaction shows itself as the result of the depression produced by the cold, and this reaction induces inflammatory action, developing either disordered circulation and sensation, as in hyperæmia, or going further and producing vesication and ulceration, the latter of which may show itself either as a simple fissure of the skin or acquire a more extended form.

Patients.—Chilblains are most common among women and children, as might be expected from the greater delicacy of their skin.

Treatment.—The treatment of chilblains may be classified as prophylactic and curative—the former being the most important. This consists in protecting the part in the first instance from cold and moisture; and, when that cannot be done, in avoiding sudden changes of temperature, by keeping away from the fire after exposure to low temperatures, and employing gentle friction. The curative treatment of chilblain is to be carried out by such means as will regulate the vascular action in the parts. As the first effect of the cold is depression, resort should be had, as a general rule, to local stimulants, a class of applications many of which are in domestic use. Thus it is very common to recommend any one suffering from frosted feet to put them every night into a bucket of hot water and mustard, a prescription that is by no means a bad one. Washes, of spirits of turpentine, of the solution of the sulphate of copper, or of sulphate of iron, or of a solution of the nitrate of silver, are often employed, of a strength sufficient to create a feeling of warmth, and are very useful in aiding the restoration of the local circulation, and relieving the disorded nervous sensibility. In the fissured form, or in limited ulcerations, collodion will be found an excellent application; but each returning winter, by inducing changes of the circulation of the affected part, will often develop neuralgic pains in the tender skin left after the primary attack.

## SECTION II.

### OF FROST-BITE.

Frost-bite presents us, in a slightly-modified form, with all the symptoms of marked inflammatory action and perversion of the local nutrition in the part affected, which have been detailed, in connection with inflammation, under the head of Gangrene. Frost-bite is, in truth, a term only expressive of the fact, as recognized by the ancients, that the gangrenous condition has been induced by exposure to cold. The portions of the body which suffer from frost-bite are very much the same as those alluded to in chilblains.

Treatment.—With regard to the indications in the treatment of frost-bite, it is a repetition of the principles laid down, when speaking of mortification, that is, to favor the formation of the line of separation and ulceration, that the dead parts may be thrown off, while we afterward promote the processes of granulation and cicatrization, that the ulcers may be made to heal, a result which it is sometimes difficult to obtain, owing to their unhealthy and irritable character. Until reaction supervenes, the treatment of frost-bite should be stimulating, as by applications of turpentine either pure or diluted, with resin cerate; or cloths wet with a dilute nitric acid, one or three drops to the ounce of water, or with camphorated spirit, etc. But after reaction, when inflammation is fully developed, the warm water-dressing, with the addition of a little of Labarraque's solution, to check the fetor from the dead portions,

will prove advantageous. The ulcers left after the separation of the dead or sloughing portion in frost-bite will require the same treatment as the ulcers left after the separation of the sloughs caused by burns, page 424.

When mortification from cold destroys a considerable portion of an extremity, as a foot or hand, or an entire finger or toe, it will be found to be good practice to amputate above the line of demarkation and in the sound tissues, at an early period, in order to escape the exhausting effects of long-continued suppuration, and expedite the process of nature. When amputation is thus performed—that is, soon after the line of demarkation is well defined—prompt union of the flap may be obtained, a sound, healthy cicatrix gained, and the patient preserved from the tedious process of cicatrization in an ulcer due to a debilitated local circulation. Few stumps resulting from the separation of a mortified part by the natural process will present a cicatrix sufficiently hard to enable it to sustain pressure until weeks have elapsed, while the flap formed by an operation offers immediately sound and healthy tissue.

Throughout the treatment of the varied local and general disorder resulting from cold, it should be remembered that patients suffer much more from changes of temperature, and from moisture and cold, than they do from mere exposure to a low degree of dry cold steadily maintained. In Baron Larrey's Memoirs it is stated that in the campaign of Napoleon in Poland, the troops under his observation would frequently do very well while marching, even when exposed to a temperature of 15° below zero, and with comparatively few cases of injury from cold; but, when a soldier came near the bivouac fires, he was apt to suffer directly from severe frost-bite, losing fingers, toes, and even limbs. He also mentions one case in which a soldier, having come from an exposure to this degree of cold, went into a warm guard-room, and immediately fell down asphyxiated, and died.*

### SECTION III.

#### OF SUSPENDED ANIMATION FROM COLD.

Another point connected with the effects of cold requires here brief reference, and that is, the suspension of animation resulting from exposure to cold for a considerable length of time. When called to a person under these conditions, the surgeon should proceed as follows, in order to restore a healthy condition of parts without creating a violent reaction: Strip the patient, carry him into a cold room, or out into the open air, if a room sufficiently cold is not convenient, and there rub him with ice, snow, or cold water, till an improvement in the condition of the circulation is perceptible. Then place him in a room the temperature of which is a little higher, and give him warm drinks, such, for example, as balm tea, elder tea, black or green tea; then apply heat very gradually, while at the same time injections of warm water may be advantageously introduced into the rectum. As the respiration gradually becomes more easy, the temperature should be slowly raised till the patient finally regains his natural healthy condition, any catarrhal or pneumonic symptoms that may be subsequently developed being treated on the general principles of such disorders when due to other causes.

The prophylactic treatment consists in keeping the circulation active and preventing the patient from becoming unconscious by constant mental stimulus; thus persons exposed to cold should, under no circumstances, be

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* Larrey, op. citat.

allowed to give way to the feelings of torpor and drowsiness which are generally induced by it.    Those who have read Captain Cook's Voyages must be perfectly familiar with the adventures of Dr. Banks and Dr. Solander, and the difficulty they experienced, when exposed to cold, in keeping each other awake.    The use of alcoholic drinks by persons exposed to cold for a length of time should be carefully watched, as they tend to augment the congestion of the brain and the disposition to sleep.

# CHAPTER V.

## WOUNDS IN GENERAL.

A **wound** may be defined as a solution of continuity in a soft tissue produced by mechanical violence and communicating with the atmosphere through a division of the integuments of the body.  As the violence creating these injuries is extremely varied, wounds have been classified in accordance with the cause that produced them : thus we have incised ; lacerated ; contused ; punctured ; poisoned ; gunshot, and railroad wounds ; or according to the manner in which the integuments and tissues are divided, as longitudinal, transverse, or oblique to the axis of the part ; and, lastly, from the region of the body where they were situated, as wounds of the head, chest, and extremities.   They are also sometimes spoken of as circumscribed and extended, recent and old, simple and complicated, these varieties requiring no further explanation at present.

All wounds, of any extent, unless promptly followed by death, are liable to create general constitutional disturbance as well as local evidences of derangement, as hemorrhage, inflammation, suppuration, ulceration, and mortification.   As the general symptoms have been already alluded to under the head of Inflammatory or Traumatic Fever, they require no further reference at present except to remind the reader that, in many instances, wounds are also complicated by erysipelas, a disorder already described.   Attention may therefore now be given to the local changes created by wounds.

## SECTION I.

### OF HEMORRHAGE FROM WOUNDS.

As the vascular supply of every tissue is quite free, and it is quite impossible to create a wound without dividing some vessel, it follows that every wound will be apt to give rise to a more or less abundant flow of blood or hemorrhage.

Hemorrhage may be either primary or secondary, that is, may either occur at the time the wound is inflicted, or some days subsequently ; venous or arterial—the first being of a purple color, and flowing in a steady stream, the latter being a bright crimson, and escaping in jets synchronously with the heart's action or per saltum.   The arterial bleeding being the most serious, attention should be first given to its arrest.

Hemorrhage is serious or otherwise in proportion to its amount and the condition of the patient's general strength.   In wounds, without assistance,

it may terminate life, while, unless promptly arrested, it may create such debility as will materially impair the subsequent reparative effort of nature. When free and unchecked, hemorrhage soon abstracts the blood so rapidly from the brain as to induce syncope or fainting, under which the action of the heart is much diminished, and time thus allowed for the contraction of the wounded blood-vessel and the arrest of the flow of blood by the formation of a clot. As it is desirable that hemorrhage should be promptly and efficiently checked, the means by which this may be accomplished are important. A few points may therefore be advantageously presented in addition to those already referred to in Part I. p. 189.

**Effects of Wounds on an Artery.**—When an artery is wounded, certain changes occur which are mainly due to the contraction of its elastic and muscular coat. Thus, a simple incision in an artery parallel to its axis becomes a gaping orifice by the contraction of the circular fibres, Fig. 189,

Fig. 189.

A DIAGRAM SHOWING THE EFFECTS OF WOUNDS OF AN ARTERY AND THE ACTION OF THE ELASTIC AND MUSCULAR COAT UPON THE SIZE OF THE ORIFICE IN THE VESSEL.—1. A simple longitudinal incision, near the bottom of the figure, which is represented as gaping at the upper end, under the action of the circular fibres of the muscular coat. 2. An oblique incision, with its consequent enlargement by the action of the muscular coat. 3. A transverse but smaller wound, which gaps much more in proportion to its length than either of the others. 4. A transverse incision of the same length as those represented in 1 and 2, but causing a very wide gap by the action of the elastic coat of the artery. (After Liston.)

and an oblique cut like that seen in the upper part of the same figure (2) is yet more widely dilated. A transverse wound, as in 3, 4, by the retraction of the elastic coat causes a more marked orifice, and one more likely to bleed freely and continuously than wounds that divide the artery entirely across, as in the latter case its calibre will be diminished by the perfect action of the circular fibres, while the elastic tissue, by drawing the vessel into its sheath or retracting it, favors the formation of a clot.

Hemorrhage resulting from the division of an artery may be arrested either by natural or by artificial means, such means being designated as hæmostatics, (αιμα, blood, στασις, stagnation.)

### § 1.—Of Natural Haemostatics.

The means by which nature checks hemorrhage are to be found, first, in the arrest of the local circulation, and, second, in the formation of a coagulum, or clot, which takes a certain position, and fills up the vessel and wound, so as to check the further flow of blood. If the artery is simply punctured, the blood will escape from it, in consequence of the gaping, caused as before explained, and be effused into the surrounding tissues so as to form a clot in them, Fig. 190, while, owing to the retraction of the vessel, the wound in the artery will no longer correspond with that in the skin. The blood that continues to escape will, therefore, also form a plug in the surrounding sheath of the vessel until it closes the wound by a firm mass, and

thus checks the hemorrhage, Fig. 191. The retraction of the vessel, by which its relation to the external wound is changed, Fig. 191, *b*, forms an important fact in the study of hæmostatics, and it should be specially remembered that when an artery is cut entirely across, it not only contracts, but also

Fig. 190.
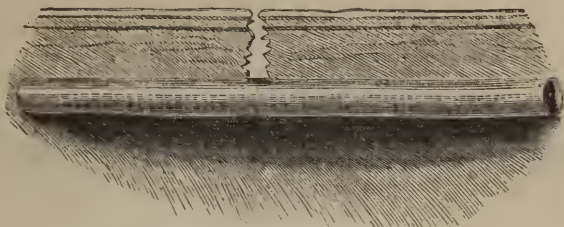


Plan of a Punctured Wound of an Artery immediately after its production; the wound in the integuments and the vessel being uniform and continuous, and thus favoring hemorrhage. (After Miller.)

retracts; or rather, it first retracts itself within its sheath, and then contracts its calibre, a change being thus made in the relative position of the opening

Fig. 191.
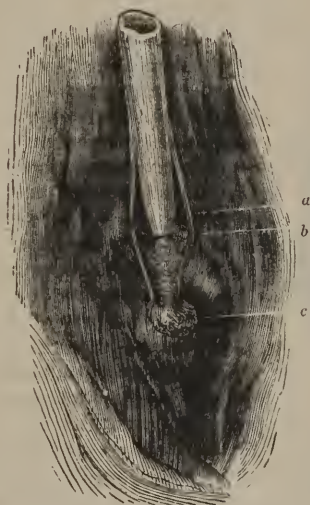


A PLAN OF THE NATURAL ARREST OF BLOOD IN A WOUNDED ARTERY.—*a*. Shows the divided end of the artery, which has assumed a conical shape by the contraction of the circular fibres of its muscular coat. *b*. The sheath of the artery left vacant by the retraction of the artery through the contraction of its elastic tissue; the sheath is seen as occupied by a clot. *c*. The clot or coagulum of blood projecting from the orifice of the sheath. (After Jones.)

in the vessel and in that of its sheath, Fig. 192; the contractile and retractile force both acting to diminish the calibre of the artery and cause it to assume a conical shape, Fig. 191. By this action the connection of the clot which forms in the vessel and adheres to its sides is facilitated, through the fibrin resulting from the irritation of the internal coat, the internal coagulum being also supported from without by the external clot. A few minutes, therefore, after the entire division of an artery, its orifice no longer corresponds with the cut end of the sheath, but must be drawn out with the forceps or with the tenaculum before it can be tied with advantage.

The natural arrest of hemorrhage owes much of its success to the fact that loss of blood produces syncope and a diminution of the force of the heart, in consequence of the want of action in the brain resulting from a reduction of its usual supply of blood, as before alluded to. During syncope the hemor-

Fig. 192.



A Punctured Artery, showing the change in the openings in the integuments and in the vessel, with the infiltration of blood and the formation of clots both within and without the vessel; that within becoming adherent to its coats, and thus firmly fixed. (After Miller.)

rhage ceases, because the blood, being no longer actively driven forward by the heart, more readily coagulates at the wound, so that when the clot forms, it is not so readily thrown off from its attachment. Faintness is therefore a condition favorable to the arrest of hemorrhage; a fact which should be remembered, because, though wounds may not bleed while the patient is in a state of syncope, yet will they frequently do so when he revives, the heart's renewed action driving out the partly formed clot. Caution is also requisite, after surgical operations, in watching for the renewal of the circulation before closing the wound, lest hemorrhage should occur subsequently from vessels whose points were not apparent at the time. But in the majority of accidents and operations, the natural hæmostatic effort cannot be relied on, as it is often uncertain, and only temporary. More permanent measures must therefore be employed, all of which have for their object the production of such a change in the condition of the artery as will lead to the formation of a permanent obstruction within the vessel, by creating a sufficient amount of adhesive inflammation to glue its walls together, and induce an entire obstruction of its calibre as high as the first anastomotic branch, Fig. 193. The arrest of hemorrhage by these means is generally described as due to artificial hæmostatics, and is essentially the same whether accomplished by the application of styptics, the ligature, acupressure, the cautery, pressure, or any other of the means before described under the head of Arrest of Hemorrhage, page 189.

Fig 193.



PLAN TO SHOW THE RELATIVE CONNECTIONS BETWEEN THE INTERIOR AND EXTERIOR CLOT OF BLOOD IN THE PROCESS OF ARRESTING HEMORRHAGE BY NATURAL HÆMOSTATICS.—a. The external clot, or that in the wound, incorporated with the coagulum as found in the sheath at b. c. The length of the internal coagulum, which generally rises as high as the point where the first collateral or anastomosing branch is given off. (After Jones.)

As the loss of blood materially influences the healing process, we may now examine the general effects of hemorrhage on the constitution.

**Constitutional Effects of Hemorrhage.**—If hemorrhage, whether primary or secondary, be not duly arrested, it produces serious constitutional disturbance, which is to be noted not only in the character of the blood that

circulates, but also in the functions of the circulation. Thus, after severe hemorrhage, the pulse becomes quick, irritable, and thread-like, and is not only quick, but frequent, counting 120, 140, or even 150 beats per minute; while from the removal of the blood corpuscles, the blood is impoverished, and there result all the symptoms of anemia, with the pallor of skin and general bloodless aspect seen in this condition from any other cause; we may also note the diminution of nutritive cell action from the want of a proper stimulus.

**Constitutional Treatment of Hemorrhage.**—In the general treatment of hemorrhage it has been recommended to administer astringents internally. These may sometimes prove useful in cases of hemorrhage where it is impossible to get at the bleeding surface, as in the case of uterine hemorrhages, etc.; but, as a general rule, these remedies are not applicable to surgical cases. Opiates, also, by diminishing the heart's action and allaying irritation, sometimes prove useful; but the chief security in the arrest of surgical hemorrhage is to be found in a reliance on local measures. Venesection is sometimes demanded for the purpose of assisting in the control of hemorrhage, as in the case of wounds of the chest, where, from excessive vascular action, the hemorrhage is troublesome, but it is only resorted to occasionally and in special cases.

Sometimes patients are seen who bleed profusely upon the most trifling injury, the prick of a needle or the scratch of a pin producing a hemorrhage which is difficult to control. Such patients are said to possess the *hemorrhagic diathesis*, and every wound to which they are exposed should, therefore, be carefully watched.

# CHAPTER VI.

## SPECIAL WOUNDS.

For the purpose of systematic study, wounds have been divided in accordance, first, with the cause creating them; and second, the region where they are found. We shall first allude to them in connection with the cause creating them, as Incised, Contused, Punctured, etc.

An **Incised** wound is one made by a clean, sharp-cutting instrument; while a **Lacerated** wound is that in which the parts are forcibly torn asunder by a blunt or dull agent.

A **Contused** wound is the tearing or division of the soft parts that results from a blow by an obtuse object, which at the same time creates more or less of a contusion or bruise.

A **Punctured** wound is one made by a sharp-pointed instrument that creates an aperture small in proportion to its depth. If such a wound passes deeply, and enters a cavity, it is sometimes spoken of as a **Penetrating** wound.

A **Poisoned** wound is one in which virus, or an irritant of some kind, is introduced; and **Gunshot** wounds include all those which are the result of the explosion of gunpowder, whether caused by a ball, a splinter, or a piece of rock, etc.

All wounds of any extent, unless promptly followed by death, are liable to create general disturbance of the functions of the economy, as well as

local evidences of derangement, as hemorrhage, inflammation, suppuration, etc., as already alluded to.

Most of the general symptoms are also those which have been previously mentioned in connection with the subject of inflammation, as Fever, Suppuration, and Mortification. They require, therefore, no special mention at present, further than to call attention to the liability of wounds to be followed, in many instances, by hectic fever or erysipelas. When either of these affections complicate wounds, the symptoms and appropriate treatment will be such as have been given in the sections on these subjects.

## SECTION I.

### INCISED WOUNDS.

**Characters.**—The edges of an incised wound are smooth, clean, and disposed to unite by the first intention, or by adhesive inflammation; the inflammatory process in a healthy patient seldom going beyond the degree necessary for suppuration or union by granulation, if the edges of the wound do not heal by the first intention. As the divided tissues gape from their own inherent contractility, the hemorrhage from an incised wound is brisk, particularly if arteries of any size have been partially divided. The entire division of a nerve is not so painful as its partial section, and its divided extremities may be induced to heal if accurately approximated.

**Diagnosis.**—The peculiarities just stated are quite sufficient to enable any one to form a diagnosis.

**Prognosis.**—The prognosis of incised wounds is generally favorable after the arrest of the hemorrhage, the tendency being to union, unless interfered with by improper treatment.

**Treatment.**—The indications for the treatment of incised wounds are: 1. To arrest the hemorrhage, which may be accomplished by some of the various means previously described under the head of Hæmostatics. 2. To remove from the wound all large clots of blood, and foreign matter of every description, such as bits of clothing, etc. 3. To coaptate the edges accurately, and retain them in position by some one of the sutures or other means already described. 4. To prevent too great a degree of vascular action—for which purpose the water-dressing may be employed when necessary. Care should always be taken to insure the escape of the extra liquid from the bed by protecting it with oiled silk.

In incised wounds, especially when they are long and of some depth, sutures are preferable, as means of promoting union, to adhesive plaster, except in wounds of the scalp, where sutures, unless of the metallic variety, are generally injurious.

*Rest* is of great importance in the treatment of incised wounds, if of any extent, as it is impossible that they should unite while the muscles near them, or which are involved in them, are constantly contracting. *Position* has also an influence upon the success of the union in many cases, and it consequently becomes an important element in the treatment. As union by the first intention should be attempted in all incised wounds, the general principles laid down, when speaking of adhesion and the organization of lymph as the result of inflammatory action, will suffice for the direction of their proper treatment. When an incised wound fails to unite by adhesion, it should be treated like the healthy ulcer, and made to heal by granulation and cicatrization.

## SECTION II.

### LACERATED WOUNDS.

A **Lacerated** wound is one in which the injury is caused by a rough or blunt-edged instrument, as a dull knife, a saw, splinters of wood, as from ships and railroad cars, or from machinery in all its varied forms, especially reaping and thrashing machines, and mills in which bands are connected with drums, rollers, etc.

**Characters.**—Lacerated wounds present ragged, uneven, irregular edges, which are very different from those of the incised wound. They also differ from the latter in the character of the hemorrhage, which is less free in lacerated than in incised wounds, because the arteries are stimulated to contraction and retraction by the violence of the laceration; while the pain is also less, from the paralyzing influence of the force that creates these injuries. Lacerated wounds also differ from incised wounds in their mode of union, healing almost invariably by granulation, because as the injury impairs the vitality of the edges, the latter are more or less disposed to slough. The immediate result of lacerated wounds is a tumefaction of the edges, with a partial arrest of the local circulation, this being followed by repair through granulations.

**Diagnosis.**—The tearing character of the force creating irregular edges; the separation of flaps or shreds of tissue from adjacent parts; the absence of active hemorrhage, etc. all render the diagnosis of lacerated from incised wounds quite easy.

**Prognosis.**—The prognosis of lacerated wounds is less favorable than that of incised—a much longer time being required for their cure, owing to the sloughing, suppuration, etc. often seen in wounds of this class.

**Treatment.**—The indications for the treatment of lacerated wounds are, in many respects, the same as those just given for incised wounds, such as the arrest of hemorrhage, if any exists, the removal of foreign bodies, and, so far as it is possible, the coaptation of the edges, every flap or detached portion being carefully replaced, if yet connected by a pedicle; but as the flaps and edges of lacerated wounds will not unite by adhesion, their accurate apposition is not so essential to the healing of the wound. The warm water-dressing is particularly applicable to this class of wounds, the sedative influence of the warmth and moisture allaying irritation, and tending to prevent subsequent inflammation and sloughing. But sometimes the languid circulation, as shown by the coldness and lividity of the edges, will demand stimulants, as sinapisms or liniments, etc. until more activity becomes apparent, when these remedies should be promptly discontinued, and the simple warm water-dressing substituted. Bathing the part with whisky or laudanum often proves a sufficient stimulant for the early treatment. All lacerated portions should be carefully cleansed from foreign matter before the flaps are replaced, with a view of obtaining union and preventing subsequent irritation and suppuration.

## SECTION III.

### CONTUSED WOUNDS.

**Contused** wounds are those produced by any cause that inflicts a bruise at the same time that it creates a solution of continuity in the tissues. With the appearance produced by a simple contusion every one is familiar, a black eye presenting a common example of it. A black eye, accompanied by a laceration or cut of the integuments, will, therefore, present a simple illustration of the condition of the parts in a contused wound.

Contused wounds being generally accompanied by more or less contusion, a slight reference to the character of the latter injury is essential.

Contusions may create four degrees of injury. In the first, there is a rupture of the small superficial vessels, and a consequent infiltration of blood into the tissues. In the second, there is a rupture of the larger vessels, and an augmented effusion of blood. In the third, in addition to the hemorrhage, there is more or less alteration and destruction of structure in consequence of the violence employed; and, in the fourth degree, the injury results in gangrene.

Under the head of contused wounds are properly grouped all the large class of gunshot wounds; but these will be reserved for separate consideration.

When the changes created by a simple contusion result in a destruction of tissue by sloughing, it creates an ulcer, not a wound, though the difference between the two is sometimes overlooked. As contused wounds and contusions are nearly inseparable, the consideration of their treatment is usually taken up under one head.

**Treatment.**—After closing a contused wound, the indications for the treatment of a contusion of the first degree are to prevent further effusion of blood and promote the absorption of that which has already escaped into the adjacent structures. Cold is, therefore, among the most valuable of our agents, the common application of a piece of raw beef, or a raw potato, or cold knife, etc., so often recommended in cases of black eye, acting simply by presenting cold to the injured parts. If cold appears insufficient, astringents may be resorted to, and cloths, wetted with lead or alum water, etc. may be laid upon the part until the swelling is checked. With the changes of color, from the primary livid purple or black, to blue, and then to yellow or green, through which an ecchymosis ordinarily passes during the absorption of the effused blood, all are familiar.

In the second class, where much blood is effused, means must be employed to favor its absorption. To do this the action of the connective tissue cells and the neighboring vessels must be stimulated, and particularly that of the veins, which are the most active agents in this process. Stimulating applications of various sorts may, therefore, be resorted to, as the tincture of arnica, spirits of camphor, and laudanum, or simple spirit, all of which stimulate, while they create cold by the evaporation of their alcohol. The first named are also useful by their anodyne effects

If the effusion of blood in a contused wound is of such a bulk that it produces great irritation, and seems likely to result in suppuration, an incision should be made, the clots pressed out, any pus that may have collected evacuated, and the case afterward treated as one of abscess.

In the third class, where there is destruction of structure, after the hemorrhage has been arrested—and it is generally slight—the wound should be

cleansed from all foreign matters, and the warm or tepid water-dressing resorted to, in order to preserve a proper circulation in parts which have had their vitality weakened by the blow. If general treatment is necessary, it should be carried out according to the principles already laid down in the consideration of inflammation. Thus, if suppuration is established, and runs on to any extent, the strength of the patient must be supported by the administration of quinia, iron, full diet, fresh air, etc., the principles being the same whether the suppuration is caused by a wound or by some other agent. The treatment to be adopted, should secondary hemorrhage come on, will be detailed under the head of Gunshot Wounds.

## SECTION IV.

### PUNCTURED WOUNDS.

**Punctured** wounds are those made by a pointed instrument. They have also been called penetrating wounds; but this is a very loose phraseology, for an incised wound may also be penetrating, as in those created by small-swords, etc.

**Characters.**—The wound of the skin in punctured wounds is usually narrow in proportion to its depth, in accordance with the nature of the point of the instrument. More or less contusion may also be present in all punctured wounds, particularly if the point inflicting the wound be blunt. Such a wound may be produced by a nail, bayonet, marling-spike, etc.

**Diagnosis.**—A careful examination will render the diagnosis of punctured from other wounds quite easy.

**Prognosis.**—The prognosis of all serious punctured wounds should be guarded until after the ninth day.

Usually, the first danger is from the injury done to important organs; hence punctured wounds are generally more serious than those resulting from any other class of weapons. Thus, if an artery be wounded, it will bleed more profusely, and if a nerve be punctured, the consequent irritation will be greater than in any other variety of wounds; hence tetanus is thought to be more frequently met with in this than in any other class of injuries, though there is some reason to doubt the correctness of this observation. The second danger is from inflammation leading to suppuration beneath fasciæ, and resulting, if the pus be not evacuated at the proper period, in extensive infiltration of the tissues. The third danger is that resulting from the presence of foreign bodies in the wound, for it may happen that the whole or a part of the instrument making the wound will remain in it, as in the case of splinters or arrow-heads. A bayonet or boarding pike, broken off in the body by contact with a bone or any other substance, will, of course, add to the dangers to be apprehended.

**Treatment.**—The indications for the treatment of these wounds are—first, to arrest the hemorrhage; second, to allay irritation; and third, to give free vent to the suppuration that often supervenes. Of course, if a part of the instrument has been left in the wound, it should be removed. In the attempt to arrest hemorrhage in punctured wounds it may be necessary to dilate the wound, in order to tie the bleeding vessel, and not unfrequently a vessel which bleeds profusely from a puncture will contract and retract upon being entirely divided, so that the bleeding will cease. Where the hemorrhage, though free, is not sufficiently so to justify the surgeon in boldly cutting down and securing the bleeding vessel, the tampon may be employed,

or a piece of patent lint, charpie, sponge, or agaric, be thrust into the wound and kept there till a clot is formed.

An important point in the treatment of punctured wounds is to employ such a small tent or meche of lint as will prevent the healing of the skin before the deeper points are thoroughly united, thus insuring a free vent for the pus, as the skin heals more readily than other tissue. Should the skin unite while suppuration is yet going on below, a large abscess would be formed, the pus from which, by infiltrating the areolar tissue, and invading muscles, and other deep-seated structures, might do much mischief; but when, notwithstanding every precaution, matter yet forms beneath fasciæ, the parts should be incised freely, to give it ample opportunity to escape. When a punctured wound has a *superficial* course, and is free from important structures, and continues suppurating for some time, with an indisposition to heal, it should be laid open by means of a director and bistoury, and then treated as an incised wound that heals by granulation.

This plan is more certain of a cure than the employment of stimulating injections into the track of the wound, but is not applicable to deep punctured wounds.

## SECTION V.

### POISONED WOUNDS.

**Poisoned** wounds are those in which, in addition to the wound, there is a certain amount of noxious, irritating matter introduced into the part. These poisonous substances are varied, and do mischief in two ways: 1. By entering the circulation. 2. By their influence on the nervous system. The virus from poisoned wounds may enter the circulation in consequence of a direct puncture of one of the vessels, or from having been placed in the areolar tissue and taken up by the connective tissue cells and the lymphatics of the part. When it is introduced through the lymphatics, inflammation of those vessels or "angioleucitis" is the result, of which a familiar example among medical men is to be found in the case of a dissecting wound. The effects from the introduction of poison into the system by a wound of a lymphatic are not, however, so rapid as when the poison is introduced directly into the circulation by a wound of a blood-vessel, as it is then brought more promptly in contact with the brain and spinal marrow, and acts directly upon them in the production of depression and the whole train of typhoid symptoms which characterize these wounds. The local effects of the introduction of a poison are various, but they are generally such as show the presence of irritating matters. Thus, there may be a violent inflammation developed, which will assume an unhealthy character, often resembling erysipelas; pus will be formed, and this will soon become ichorous, the inflammation being accompanied by ulceration or sloughing, which spreads with rapidity.

Poisoned wounds may be classified according to the character of the poison introduced; as those arising from the stings of insects, from the bites of serpents, of rabid animals, etc.

### § 1.—Poisoned Wounds from the Sting of Insects.

The stings of insects produce a poisoned wound of the simplest class; the wound being a mere puncture, and the irritation created by the poison not very violent. They generally give rise to no constitutional symptoms, unless the number of the bites or punctures is very great, as in the case of bees,

which, when swarming, have been known to cause the death of the person stung.

In the bite of the *musquito* or *bedbug* there is a slight amount of irritation produced by the saliva of the insect, which is effused into the wound during the process of mastication, the wound being made in the act of feeding.

**Diagnosis.**—A careful examination of the wound inflicted by the sting of bees, wasps, hornets, etc. will generally exhibit the sting of the insect imbedded in the wound, which, with the history in severe cases, will render the diagnosis easy.

**Prognosis.**—In numerous injuries by bees or wasps, and especially in those within the mouth and throat, or in the eye, the stings may create such irritation as will be very troublesome. They should not, therefore, be too lightly spoken of, though seldom fatal except in attacks from swarms.

**Treatment.**—The salivary matter injected or allowed to flow into the wound after puncture by an insect, as a spider or bug, being generally acrid or acid in its character, the external application of alkalies, as aqua ammonia, liquor potassæ, salt and water, with subsequent applications of the cold water-dressing, nearly always suffices to remove the irritation.

The sting of the bee or wasp presents also the same general facts, though in these insects there is a wound made as the result of an attack, the puncture and the introduction of certain acid irritating matters secreted by a gland, and contained in a little sac at the base of the sting, being resorted to as a means of offense and defense. The wound made by the sting of the bee, wasp, or hornet is usually very small, but is soon surrounded by a certain amount of inflammation, which is indicated by more or less redness, pain, heat, and swelling, the latter being generally of an œdematous character. When the sting remains in the wound, it may be recognized as a fine, black point like a needle. As it would prove a source of irritation if allowed to remain, it is necessary to withdraw it, and this may be done by seizing it cautiously with fine forceps; after which the application of the various alkalies will prove useful by neutralizing more or less the poison introduced.

When the bites of wasps, hornets, or bees are very numerous, the multiplication of irritation will sometimes produce constitutional disturbance, the amount of injury necessary for this purpose being much less in persons of intemperate than in those who are of temperate habits. Indeed, in persons whose blood has become depraved by intemperance, the most trifling injuries will sometimes prove fatal; thus, there are cases on record where the individual has died from the bite of the common spider.

There is one case, however, in which the sting of a single bee or wasp may prove seriously injurious, and that is where it is inflicted in the fauces, as may happen when the insect is taken into the mouth in a piece of honeycomb, the swelling of the fauces rapidly proving fatal by creating œdema of the glottis, and preventing the entrance of air into the trachea. In such a case, cooling or detergent gargles would be the proper class of local applications; or scarifications of the glottis or tracheotomy might become requisite if positive strangulation and œdema of the glottis supervened.

### ℥ 2.—Of the Bites of Serpents.

There is a large number of serpents capable of causing serious danger to life by their bite. It is not necessary, however, to enter into all the details of these; the Cobra di Capello and other Asiatic snakes being not likely to come under the observation of American surgeons. The Copperhead, and

other venomous snakes of the United States, cause by their bite a series of symptoms which are embraced with but little variation in the following details of the bite of the Rattlesnake.

The rattlesnake, it is said, seldom bites man except in self-defense, and generally gives warning of his presence by means of the little apparatus in his tail, from which he derives his name. In making the wound, the poison is introduced through a puncture made by a long, sharp tooth in the upper jaw, Fig. 194, corresponding in position with the canine tooth in the dog.

Fig. 194.



VIEW OF THE HEAD OF THE RATTLESNAKE, SHOWING THE POSITION OF THE POISON GLAND AND ITS EXCRETORY DUCT.—*a, a.* Poison gland and its duct; the latter being cut open at its extremity. The other letters of reference relate to the muscles and ligaments of the jaw. and have no special connection with the subject surgically. (After Cyclop. of Anat. and Physiol.)

This tooth is not firmly attached to the jaw, but is movable, being acted upon by certain muscles. It is also hollow, and contains at its base a little sac, which communicates by means of a duct with the poison gland. When the snake strikes, it raises itself in a coil, throws its head back, and then strikes downward, the tooth making a wound from above downward; the contraction of the muscles in erecting the tooth acting upon the sac at its base, and the poison being forced out by the side of the tooth into the wound, Fig 195. The poison thus introduced may prove rapidly fatal, particularly if the wound has been made directly upon the skin, and not through clothing. Death follows most rapidly if a small vein or artery is punctured, occurring in certain of the lower animals in as short a time as nine minutes; but when the poison is simply introduced into the areolar tissue of the parts the symptoms are less imminent, and are as follows:—

Fig. 195.



A MAGNIFIED VIEW OF THE POISON FANG.—*p, p.* The cavity of the tooth. *v. v.* The canal along which the poison flows on the outside of the tooth. (From the same work.)

**Symptoms.**—Shortly after the puncture of the bite, a pain of a burning, tingling character is felt, which is particularly violent, and sometimes creates a brief spasm if one of the cutaneous nerves has been wounded. The part then swells rapidly, an arm that has been bitten becoming double its natural size three or four hours after the injury. This swelling is not like that of healthy inflammation, but rather resembles the œdematous swelling, with the fetid, ichorous infiltration of the areolar tissue, seen in gangrene. Sometimes it goes to such an extent that the skin gives way, and the liquid products of diseased action are effused.

This condition of the areolar tissue is sometimes designated as "cellulitis gangrænosa," of which I have one fine specimen in my cabinet from the bite of the rattlesnake. Should the lymphatics be the medium by which the poison is absorbed, inflammation will be noticed in their course, and enlargement of the lymphatic glands be observed; but generally the swelling is so great as to prevent this from being seen. Sometimes the wound and the adjacent parts become truly gangrenous, and large sloughs come away. Sometimes, on the other hand, it ceases to be apparent, and the course of the affection can only be ascertained by the history of the case.

The general symptoms which are developed at various periods after the injury are those of depression, which sometimes come on very rapidly, the patient dropping suddenly as if struck dead. Sometimes, and most commonly, the progress of the case is more deliberate; there are nausea, vomiting, high febrile action, delirium, a sense of constriction in various parts of the body, typhoid symptoms, and death, preceded by coma or by convulsions.

The activity of the poison and the rapidity of its action seem to depend upon the condition of the serpent; thus, one which has just bitten several other animals, will not prove so venomous as one which has not bitten anything for some time. The experiments of Barton and of Hall, in the early part of this century, as reported in the *American Philosophical Transactions*, are very interesting in this connection. They found, upon making a serpent bite five or six chickens, or other small animals, that those last bitten did not die so soon as those first wounded. So also certain seasons seem to have their influence upon the venom of the snake, bites inflicted in August being more apt to prove fatal than those received in colder months.

*Treatment.*—The indications for the treatment of the bites of serpents are two: 1. To check or prevent the absorption of the virus. 2. To prevent the depression from proceeding to such a point as to prove fatal.

These indications are to be fulfilled by both local and general measures. The local means to be employed in fulfilling the first indication are such as attempt the removal of the poison. If the patient be in the woods at the time of the accident, and without other means, he may, without hesitation, suck the wound, with the view of extracting the venom, for it has been found that when applied to mucous surfaces upon which no abrasions exist, the poison is innoxious. The wound should also be incised freely with some sharp instrument, to provoke hemorrhage, in hopes of washing out the noxious matter. If the patient is so situated that a cupping-glass can be obtained, it should be placed over the wound, as recommended by Sir David Barry, in order to prevent absorption. Teamsters on prairies, when bitten, are, I have been informed, in the habit of surrounding the limb with a tight ligature; but this can only act temporarily, and when the ligature is removed, permits absorption to go on with even greater rapidity. It has also been recommended to wash the wound with liq. ammon. or liq. potassæ, with the view of neutralizing the acid of the poison; and Brainard, of Chicago, who has experimented largely on the effects of the poison on animals, advises the injection into the wound of—

> ℞.—Iodinii, grs. x;
> Potas. iod. grs. xxx;
> Aquæ, f℥j.

S. Weir Mitchell, of Philadelphia, found, however, that iodine as a local antidote utterly failed.[*]

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[*] Researches on the Venom of the Rattlesnake. Smithsonian Contribution, p. 112, 1861.

The use of caustic has also been recommended, but as it is liable to pre-
vent hemorrhage, it may tend to promote the absorption of the virus, though
its subsequent application, for the purpose of exciting healthy inflammatory
action in the wound, may prove useful.   When the areolar tissue sloughs,
and the integuments are distended by liquid effusions, as in gangrene, they
should be evacuated by free incisions, and the parts covered by stimulating
washes or poultices.    The general treatment will vary with the stage;
in some cases it may be advisable to commence by vomiting the patient and
purging him freely, in order to equalize the portal circulation, irregularities
in which are said to be among the first effects of the poison.    But the chief
indication is to counteract the depression by stimulants, such as ammonia
and alcohol.    Opiates have also been suggested, and may prove useful by
allaying irritation, but they should not be carried so far as to add to the
depression.

Peake, of Mississippi, has reported* a case of rattlesnake bite, in which
the patient chewed and swallowed promptly two ounces of tobacco, which
did not even nauseate him.    The limb swelled very little, and the next day
the patient was about and well.

In regard to the alcoholic treatment of these snake wounds, there is a
popular idea that if a person bitten by a rattlesnake is able to get drunk, he
will not die.    It is, therefore, by no means uncommon for persons, when thus
bitten, to procure a quart of whisky and drink to extreme intoxication, and
I have been frequently told, by army officers and others, that such is a very
common practice among the teamsters and soldiers who have come under
their observation.    But although this treatment has been successful in many
cases, yet, if the alcohol be so given that its depressing effects come on simul-
taneously with the depressing effects of the serpent's venom, a delicate pa-
tient must certainly succumb.

The evidence in relation to the relief given by the free use of alcohol,
*judiciously* administered, is so strong that few, I think, would be justified in
not resorting to it.    The following testimony has been politely furnished
me by Surgeon G. E. Cooper, of the United States Army:—

"During five years service in Western Texas, where, perhaps, the Crotali
are more numerous than in any other part of our country, I found the acci-
dent, though not rare, by no means a common one.    During my term of
service at Fort Duncan, on the Rio Grande, a period of four years, but one
case occurred.    In the practice of Surgeon Getty, at Fort Inge, on the
Leona, during a period of three years, but two cases occurred.    Since my
arrival in New Mexico, in August, 1854, I have had to treat two cases, one
at Fort Fillmore, and one at Fort Bliss, forty-five miles distant.

"In each and all of these cases referred to, both in my own and Surgeon
Getty's practice, whisky or brandy was the principal remedy used.    Liga-
tures were applied to the limb above the seat of the wound, and thus par-
tially prevented the action of the superficial absorbents; but they were not
applied for some time, nor did they prevent the swelling of the limb above
the ligature.    The liquor was given, at first, in tumblerful doses, and con-
tinued in half tumblersful until the patient fell perfectly drunk; and when the
effect of the alcohol was passing off, he was made to drink as long as any
whisky would remain on his stomach.    Cold water-dressing was applied to
the wound, and this was all the treatment used.

"In all the cases treated by me the patient recovered.    In the patients
treated by Surgeon Getty whisky was the main remedy.    If my memory

fail me not, lint, saturated in ammonia, was applied to the part struck. In one of the cases, I am informed, the soft parts sloughed to the elbow-joint, but the patient eventually recovered.

"It was really gratifying to observe the effects of the remedy. No sooner had the patient fallen under the effects of the alcohol, than the wounded part, which till then continued to swell, immediately began to cease swelling, and the muscular jerking, a source of great pain to the sufferer, ceased, and from that moment convalescence began. It is almost incredible, when the amount of liquor required to intoxicate a bitten person is told. In one case it required a bottle of brandy and a bottle and a half of whisky before any observable effect was produced. In another, two bottles of proof Bourbon whisky were used.

"The effects of the poison were to prostrate the nervous power and cause reduced action in the circulatory system, and even ecchymosis immediately occurred around the wound, the integuments in the vicinity being in a short time elevated into blebs. As soon, however, as the effects of the alcohol were observed, a greenish serous fluid commenced to ooze from the orifices of the wound, which, when brought in contact with polished steel, instantly turned it black. As this oozing commenced, the swelling of the part diminished. The part struck, and a greater or lesser amount of the integuments in its vicinity, mortified and sloughed out.

"I know of another case, occurring in an officer of the Fifth Infantry, at Ringgold Barracks, Texas, in which whisky was the remedy used with most happy effects.

"In fine, I know of no better remedy, nor do I want a more certain one; but it must be used in time, ere the whole integuments covering the bitten limb have become discolored, and the poison produced too much change in the blood, and caused such prostration of the nervous system as to render reaction impossible. I cannot tell what is the action of the alcohol, nor do I wish to theorize on the slight experience I have had. I simply state facts, feeling confident that any one who will make use of the whisky treatment, in preference to all known at present, will have no cause to regret it. It is a remedy long known and used by the hunters and trappers of the Rocky Mountains, who, when asked what they use when bitten by a rattlesnake, will, to a man, say whisky. Nor do they dread the bite, if they are where whisky can be procured."[*]

Another remedy highly esteemed is that recommended by Prof. Bibron, and is as follows:—

R.—Potas. iod grs. iv;
    Hydrarg. chlorid. corrosiv. grs ij;
    Bromine, $\mathfrak{z}$v.
S. Ten drops, diluted with one or two tablespoonfuls of brandy, as a dose, to be repeated every half hour, if required

This remedy must be kept in glass-stoppered phials.

Assistant Surgeon Hammond, United States Army, reports[†] one case of a man cured by two doses of this antidote, and also several successful experiments on animals. S. Weir Mitchell[‡] "conducted 16 experiments with scrupulous care, but found the results nearly negative." Stimulants, administered so as to avoid extreme sedation, he thinks useful, suggesting the value of the "inhalation of the fumes of warm alcohol, or even of ether, if used with caution."[§]

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* MS., 1857.
‡ Op citat., p. 114.
† Hay's Journal, Jan. 1858, No. 69, N. S.
§ Op. citat., p. 116.

The bite of the Tarantula, though often referred to with a certain amount of superstition and poetic license, occasionally is seen to induce evidences of depression entirely different from the dancing emotions ascribed to it by the people in Italy.

In a case reported by Heard, of Texas,* a patient, aged twenty, in good health, was bitten on his right hand.  No swelling or other evidence of inflammation ensued, but the patient remained depressed, with shivering, cold, clammy skin, and sunken countenance.  After administering morphia, ether, carbonate of ammonia, spirits of ammonia, and camphor, without effect, he was bled, and obtained complete relief.

### § 3.—Of the Bite of Rabid Animals.

In the case of the bite of a rabid animal, the danger proceeds from the introduction into the wound of a modified secretion of saliva, which, under certain circumstances, becomes a real poison—at least such is one view of its origin, while another ascribes its source to the development of poison sacs, etc.    The first view is certainly the most rational.

When the poisoning proceeds from the bite of a dog, it has received the name of **Rabies Canina** ; though the same class of symptoms may be caused by the bite of a wolf, of a cat, and it is said also of a jackal or badger.  The most common cause, however, is the bite of a dog.

A dog infected with rabies, either from a bite or from any other cause, shows—first, according to Youatt, to whom all are largely indebted for his investigations of the subject, and from whose description I have eliminated most of this account—a change of disposition ; and there is no question of this modification of disposition being due to a change in the condition of the nervous system of the animal.  It is characterized by the dog first exhibiting restlessness ; then becoming cross, and disposed to growl and bark at everything ; then, as the diseases progresses, he shows a greater or less amount of ferocity, runs wildly about, biting at every one, and even at those to whom he has been most attached.  From the nervous excitement, and its effects upon the laryngeal muscles, as well as the mucous lining of the larynx and trachea, as in croup, there is a change in his voice, and he barks in a peculiar manner.  The tongue is hot and the mouth dry, the animal running with his tongue hanging out, while he licks stones or any cold substance that comes in his way, in the vain attempt to cool his fevered jaws.  Next he shows disorder in the digestive organs, as if the disease, traveling down the spinal marrow, excited, first, derangement in the centres presiding over the mouth and throat, and then in those regulating the digestive apparatus.  The appetite now becomes morbid ; he eats straw, dirt, stones, rags, anything that presents itself, and a post mortem has not unfrequently shown large quantities of these substances in his stomach and bowels.

It has been established by Youatt that the popular idea that a mad dog shuns water is erroneous.   There are cases on record in which the dog has given the fatal wound when in the very act of drinking ; one case occurring in England, in which a man was bitten by a dog which he took from a canal, in which the animal was playing—he fearing it should be drowned ; he was seized by hydrophobia and died.  Rabid dogs have also been found dipping their heads into the water up to their eyes, to relieve the parched condition of the mouth and tongue.

By the bite of a rabid dog, the saliva may be introduced either by the

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tooth, or it may adhere to the paw, as it is thick and viscid, and the dog, after scraping it from his mouth, may scratch some one with the paw, and thus inoculate him; or a dog may lick the hand or face of his master, and thus bring the saliva in contact with some previously existing abrasion.

These facts show how the disease may originate in those cases which are occasionally reported, in which the patient is said, and perhaps truly, never to have been bitten by a dog, as the existence of idiopathic hydrophobia in man seems highly improbable.

The inoculation having been effected, the disease may be divided into several stages for the purposes of study :—

1. The period of incubation varies widely in point of time, sometimes lasting forty days, sometimes three or six months; and cases are on record in which six or even twelve years have elapsed between the date of the wound and the appearance of the disease.

The condition of the wound also varies; generally it heals readily; sometimes, however, at the time of the commencement of the disease it suddenly becomes livid and inflamed, with the cicatrix elevated above the surrounding skin, and causes acute pain.

2 After a period of incubation of greater or less duration, the patient begins to complain of some uneasiness, and a slight irritation may or may not call his attention to the wound; his disposition is changed, he becomes irritable, and peevish or gloomy, and despondent; slight chills, followed by fever, occur perhaps several times through the day, and there is headache, loss of appetite, and general signs of nervous derangement. Stiffness of the neck and soreness of the pharynx are noticed, and perhaps pain in the epiglottis. The tongue is dry and feverish, but in the attempt to swallow a little water for relief, violent spasms in the throat are induced because the muscles of deglutition will not carry the fluid down into the stomach. As this spasm passes off it leaves the patient in a condition of great mental distress, because he now recognizes the nature of his complaint.

A second or third effort at deglutition—for strong-willed patients will sometimes persist in making the attempt, as if they could thus prolong life— produces effects which are truly deplorable, terrible spasms of the pharyngeal muscles being induced, while the patient, half choked, struggles for air. The eyeballs stare wildly, and become prominent, and cold perspiration stands out over the features, which are frightfully distorted. In time the nervous irritation becomes such that the most trifling cause will bring on a renewal of the spasms; the slightest noise, the closing of a door suddenly, the air from an open window, the breath from the mouth of a friend, produce spasms of the most terrific order. Now, also, appear that dislike and terror of fluids which have given its name to the disease, the patient associating the idea of fluids with his spasms, because it was during swallowing that they first appeared. He, therefore, dreads their approach, and the mere sight of them will often be sufficient to throw him into uncontrollable convulsions.

From nervous excitement and derangement of the innervation of the laryngeal muscles, as well as a certain amount of œdema of the vocal cords, there is now also alteration in the character of the voice, which becomes hoarse and peculiar, so that the patient is often popularly said to bark like a dog.

As the disease progresses, the thick, viscid saliva accumulates and impedes respiration, and the patient, to get rid of it, hawks and spits violently in all directions. This occasionally gives rise to great fears among his friends, lest they should be inoculated; but there is no danger of such a result, unless the matter should come in contact with an abrasion or wound, a fact which

should be impressed upon the minds of the friends, or fear will sometimes interfere with the dictates of humanity.

Maniacal excitement now comes on; the patient rushes wildly about, and attempts to destroy himself, or to injure those who surround him. In this he should be restrained by a couple of stout assistants, and not by the strait-jacket, if it can be avoided; for while the latter secures the friends, it does harm to the patient.

This state of things, however, cannot last long, and the patient dies, asphyxiated, exhausted, or in convulsions.

**Pathology.**—A post-mortem examination shows that the symptoms must have been due chiefly to nervous derangement, as there is usually congestion of the great nervous centres, the brain and spinal marrow being more or less tinged, while there is also an inflamed condition of the mucous membrane of the fauces and stomach.

In a case reported by J. B. Reynolds,* the following appearances were noted: "On making an incision along the back about f℥iss of black fluid blood escaped; there was also blood between the bones and the membranes of cord; the spinal cord on being removed presented no morbid appearances; on opening the theca, there was considerable congestion of the vascular membrane, the blood being fluid. On removing the calvarium, the vessels of the dura mater were very much engorged; on removing this membrane, the pia mater was found congested; puncta vasculosa abundant; contrast great between cortical and medullary substance; cortical darker than usual. The heart was contracted, showing what formerly would be called a marked case of concentric hypertrophy."

Some time since, in the post-mortem examination of dogs dying from hydrophobia, little yellow follicles were found under the mucous membrane of the tongue, and these were supposed to be the efficient cause of the disease; but further examination has shown them to be merely the result of follicular inflammation, and that the appearances in question are only the mucous follicles of the tongue distended with pus in consequence of inflammation.

**Diagnosis.**—Certain authors have gone so far as to deny that hydrophobia has any real existence, and the fact of its extreme rarity has aided them in this supposition, they having ascribed all the phenomena just detailed to tetanic spasms. But this opinion cannot be maintained, as the disease has been observed too frequently and too carefully for us to doubt its existence. I have personally seen one case, and fortunately but one, for the horrors of the death of the man in whom it occurred are not easily forgotten. Those familiar with the signs of tetanus, moreover, will at once perceive that the symptoms before described are very diverse in their characters. In tetanus the mind is generally clear to the last, and the patient quite rational and without any of those maniacal symptoms which have been described. In tetanus the spasms involve the whole frame: there is opisthotonos, emprosthotonos, or pleurosthotonos. In hydrophobia the muscles of the throat only are involved, so that I consider disbelief in the existence of the disease entirely gratuitous, and the confounding of it with tetanus an error.

### SMITH'S STATISTICS OF HYDROPHOBIA.

J. Lewis Smith, of New York, has tabulated† 131 well-authenticated cases of hydrophobia, which proved fatal, of which

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* N. Y. Journ. Med , vol. ii. 3d Series, p. 215, 1857.
† N. Y. Journ., N. S., vol. xv. p. 233; also vol. xvi , N. S., p. 48, 1855.

10 were due to the bites of cats.
7    "        "        "    of wolves.
1 was owing to the bite of a fox.
1    "        "        "  of a raccoon.

And the remainder to the bites of dogs.    Eighteen of the patients were females.

In age, the patients ranged from 3 years to 73.

The details of the cases give the months when 105 patients were bitten, and 107 became hydrophobic, and exhibit the popular error of hydrophobia being most common in August :—

|  | Bitten. | Became hydrophobic. |
|---|---|---|
| January | 5 | 10 |
| February | 7 | 6 |
| March | 5 | 7 |
| April | 8 | 5 |
| May | 9 | 9 |
| June | 11 | 11 |
| July | 9 | 10 |
| August | 13 | 6 |
| September | 13 | 10 |
| October | 10 | 11 |
| November | 6 | 18 |
| December | 9 | 4 |
|  | 105 | 107 |

It is thus apparent that hydrophobia is more frequent in November, October, and June, than in January.    The discrepancy in the total of cases, in the above table, leaves two unaccounted for among those bitten.

The period of incubation was, in

| 1 case | 10 days. |
|---|---|
| 1 " | 13 " |
| 1 " | 17 " |
| 2 " | 18 " |
| 1 " | 19 " |
| 1 " | 20 " |
| 4 " | 3 weeks. |
| 10 " | 3 to 4 weeks. |
| 18 " | 4 " 5 " |
| 13 " | 5 " 6 " |
| 19 " | 6 " 8 " |
| 13 " | 8 " 10 " |
| 18 " | 10 " 14 " |
| 14 " | 14 weeks to 6 months. |
| 9 " | 6 months to 12 months. |
| 1 " | 15 " " " |
| 1 " | 5 to 6 years. |

The disease, with rare exceptions, terminated within four days.

The same author tabulates 20 *doubtful* cases, of which 10 recovered.*

The same author tabulates 6 cases regarded by him as genuine hydrophobia, which terminated in recovery ; 5 of these were in males, 1 in a female.

The treatment employed was as follows :—

Case 1 ..............................Purgatives and stimulants.
  "   2 ..............................      "      arsenic, and incision.
  "   3 ..............................   "      leeches, and opiates.
  "   4 ..............................   "      calomel, and opiates.
  "   5 ... .........................Calomel and free incision at wound.
  "   6 ..............................Opiates and anæsthetics.

* N. Y. Journ. Med., N. S., vol. xvi. p. 317.

**Treatment.**—The *treatment* of hydrophobia may be divided into two stages :—

1. That proper immediately after the bite, or the prophylactic.

2. That proper after the disease has fairly set in, or the curative, though many regard it as doubtful whether any patients affected with true hydrophobia have recovered, notwithstanding such have been reported on high authority.

Immediately after receiving a bite from an animal known to be rabid, the parts containing the wound should be cut out, and the actual cautery or caustic potash applied. If the patient dreads the pain of the operation he may be etherized; *this is a certain preventive if it be properly done,* even if practiced several days subsequently.

Youatt was bitten, or permitted himself to be bitten, over and over again, and by pursuing this treatment never suffered any inconvenience, but has lived to write many excellent works, and to that on the dog we are largely indebted for our knowledge of hydrophobia.

After the disease has fairly set in, various plans of treatment have been suggested; it has been advised to bleed *ad deliquium animi,* and to keep the patient immersed in a warm bath. Magendie thought a cure could be effected by the injection of warm liquids into the blood. Blisters to the spine have their advocates, and so has ice to the throat. The introduction of the woorara poison into the system so as to produce asphyxia has also been suggested, in the hopes that as the patient recovered from the effects of this potent agent he would be found to have escaped from the disease.

J. E. Legget, of Maryland, has recently reported[*] a cure of hydrophobia by drachm-doses of calomel. The patient was first bled 36 ounces, and then given drachm-doses of calomel every 4 hours if the spasms continued; every 6 or 8 hours, if they abated. Ptyalism was established on the third day, and this was supposed to eliminate the poison. Exhaustion was counteracted by quinine, and on the eleventh day the patient was cured. In so hopeless a disease a reported cure should justify further trials of the treatment, even if theoretically doubted as likely to prove useful.

Chloroform and ether have been given with a view of producing anæsthesia. Tracheotomy, as suggested by Physick, of Philadelphia, has been performed under the idea that constriction of the larynx producing suffocation was the cause of death, but the patient has died even when the operation has been performed early in the disease. All these various remedies will doubtless fail when applied to a well-marked case; and there is, in fact, no successful treatment known after the disease is thoroughly developed. All, then, that can be reasonably expected to be done is to add as much as possible to the comfort of the patient until death closes the scene. But the hopelessness of this treatment should only stimulate both patient and surgeon to the most thorough cauterization of every wound made even by a *suspected* animal.

### § 4.—Of Dissecting Wounds.

**Dissecting wounds** are poisoned wounds which arise from the irritation produced upon the hand or arm by wounds from instruments used in making dissections or post-mortem examinations, or from scratches with spiculæ of bone, or from absorption by the long-continued immersion of the hands in the fluids of the bodies of patients who have died of certain diseases, as peritonitis and erysipelas. The accounts of this subject in most of the books have reference rather to the complaint as it exists in Europe, than as it is

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[*] Am. Journ. Med. Sciences, January, 1860.

observed in this country, and to the results of post-mortem examinations, rather than of wounds inflicted by medical students during a course of dissections.

As a general rule, these wounds, when troublesome, are produced by a puncture; injurious consequences seldom resulting from an incised wound, probably because of the more free flow of blood washing out the virus.

When serious symptoms result, the promptness with which they are produced, and their severity, appear to be dependent rather upon the constitution of the individual wounded than upon the character of the dead body from which he has been inoculated, a simple punctured wound unconnected with any poisonous matter having been known to produce all the symptoms of angioleucitis or inflammation of the lymphatics usually observed in this class of wounds. Thus, the slight pricking of the finger with a needle or pin, in persons whose constitutions have been impaired by any cause—as by confinement in the wards of badly-ventilated hospitals—has been known to produce a train of symptoms closely simulating those of the dissecting wound. Wounds received during post-mortem examinations act much more frequently as an exciting cause than dissecting wounds, because the various solutions, such as the chloride of zinc or the salt mixture now usually employed for the preservation of the dead body, so modify the putrefactive processes as to render the wounds received quite innoxious in the great majority of cases. Wounds which result from injuries received in the dissection of subjects thus injected have, therefore, rather the character of irritated than of poisoned wounds. The treatment is in consequence simpler, the recovery more rapid, and it is one great recommendation of these antiseptics in practical anatomy that, while preventing odor and keeping the atmosphere pure, they also protect the constitution of the student, and modify the consequences of the wounds which sometimes follow careless dissection.

In post-mortem examinations, however, where the patient has died from such diseases as erysipelas, typhus fever, small-pox, etc., where the fluids are more or less changed in their character, there is certainly danger of serious consequences; and if these fluids should be of an extremely irritating character, as in those dead of peritonitis, it is not even necessary that the surgeon should wound himself or have the slightest abrasion upon the hands in order to have deleterious effects induced. On account of this danger, the hands should always be well oiled before commencing such a post-mortem examination. In dissections and post-mortem examinations, wounds can, however, be avoided by taking care to saw the bones smoothly so as to leave no spiculæ to hurt the hands, or by a little care in the use of the double hooks or of the tenacula.

**Symptoms.**—Whenever inflammatory action is developed in a wound made during a dissection or a post-mortem examination, the following symptoms may ensue: The patient experiences first a greater or less amount of smarting or irritation in the part, or there may exist in it a certain degree of pain for a few hours, after which he will begin to suffer some constitutional disturbance, as a general feeling of languor, loss of appetite, indisposition to take exercise, with very frequently more or less diarrhœa. Diarrhœa, indeed, is by no means uncommon among anatomical students, even when not wounded, especially those coming from the country and dissecting steadily for the first time. After these symptoms, inflammation is observed along the line of the lymphatics, which become red and swollen; the cuticle is elevated at the original wound and presents patches of vesication; the limb begins to swell; in fact, we have all the symptoms of angioleucitis, accompanied by the erysipelatous or unhealthy inflammation produced by any other cause. In order that every case of inflammation of the lymphatics shall not be regarded as evidence of poison, by dissectors, it may be stated that these symptoms

have been known to be induced by so trifling a matter as paring a nail too closely. I have also seen inflammation of the lymphatics of the arm and suppuration of the glands of the axilla supervene on a trifling fall, which simply abraded the skin of the hand and rubbed a little dirt into the abrasion.

As the inflammation progresses it generally takes on the erysipelatous character, and travels up the arm, and if the glands of the axilla become involved, they may run on to suppuration, with all the results of the formation of pus in the loose areolar tissue of the axilla. With this local inflammatory condition there is usually combined great nervous disturbance, which is shown in anxiety, despondency, restlessness, and inability to sleep, the latter being so marked that four hundred drops of laudanum have been given every two hours without producing narcotism or inducing the slightest anodyne effect; there is also often fever, headache, and great prostration. As the disease progresses, the ordinary evidences of blood poisoning appear, and the symptoms assume a typhoid character.

Treatment.—The treatment is divided into three stages: 1. The prophylactic. 2. The abortive. 3. The curative.

1. The prophylactic treatment of dissecting wounds consists in avoiding exposure to irritation by keeping the hands carefully out of the way of sharp spiculæ of bone, and avoiding punctures with the double hooks, the needles and tenacula, as well as by covering any little abrasions or wounds which may exist with collodion, before placing the hands in the fluids of the body. But if, notwithstanding all caution, effective inoculation takes place, the abortive treatment must be resorted to.

2. The abortive treatment is as follows: So soon as the wound is observed, if the patient is not very fastidious, he may at once place it to his mouth and suck it, spitting out his saliva afterward; then, if the part will permit it, a cupping-glass should be applied and suction produced, as recommended by Sir David Barry in the case of poisoned wounds, when, if inflammation follow, it should be combated on general principles, by means of the warm water-dressing or warm poultices. Should the inflammation continue to extend up the arm, and the lymphatics become involved, a strip of blistering plaster, or some stimulating ointment, may be applied two inches above the inflamed part around the course of the lymphatics so as to induce healthy inflammatory action, this often arresting the progress of the disease toward the deep-seated glands.

The constitutional treatment of these wounds is all-important, and it is generally well to begin by administering an emetic and a purge with the view of clearing out the alimentary canal, following it by large doses of opium frequently repeated. The opium here serves the double purpose of quieting the nervous irritation and vascular action, and of securing rest and freedom from pain. As a general rule, the antiphlogistic treatment of inflammation is badly borne in these wounds, on account of the previous debility and constitutional derangement which so often exist. Local blood-letting, at some little distance from the wound, will sometimes, however, prove useful; but leeches should never be applied near the wound itself, or their bites will exaggerate its already irritable condition.

A plan of treatment which has been highly lauded and often pursued, is to cauterize the wound freely with nitrate of silver so as to produce an eschar. Experience has, however, shown me many cases in which this treatment has increased the symptoms, and I believe it does so in the majority of cases by adding to the inflammation and irritation of the wound, and by forming a slough, which, by preventing the escape of the noxious fluids, favors their absorption. I therefore advise the student to abstain from the use of the nitrate of silver in the early period of this injury.

### ? 5.—Wounds from Diseased Animals.

The next class of wounds are those from diseased animals; and under this head may be considered the complaint designated as Glanders or Equinia. Glanders results from an inoculation of matter from diseased animals of the horse tribe. The disease in the horse or ass, which generally produces the complaint in man, is an affection of the glands of the mucous membrane of the nose, or of those of the skin. When developed, the unhealthy pus from the abscesses, or from the mucous membrane of the nose, will readily inoculate man if applied to an abrasion in the skin, or to a mucous surface.

When the glands of the neck and throat of the horse are affected by this disease, and abscesses form under the skin in various places, numerous soft, doughy tumors appear, and the disease is designated as **"Farcy,"** the inflamed glands from which it results being called "farcy buds." When the nasal membrane is the seat of the disease, it receives the name of " Glanders." Farcy may result in glanders, but it most generally succeeds it.

The inoculation of glanders, which is a rare disorder in the United States, may be accomplished in many ways: Thus the groom may dust the horse's face with a handkerchief and afterward use it to blow his own nose, or he may use a sponge upon the mouth and nostrils of the animal and afterward wash his own hands and face in the bucket into which it has been thrown. So that a man will frequently be inoculated, in countries where the disease is common among horses, without knowing it, and therefore, when cases present the symptoms now to be described, the previous history and acts of the patient should be closely investigated.

**Symptoms.**—Inoculation having occurred, the patient first complains of a general feeling of uneasiness and indisposition, low spirits, wandering pains, feverishness, a feeling of oppression in the chest, and all the symptoms of blood poisoning. Soon, however, the case becomes more characteristic; diarrhœa appears, the fever rises in grade, while in about eight or ten days a tumor of the face, apparently connected with inflammation of the antrum, is observed, and a viscid discharge of a yellowish or brownish color, often stained with blood, and offensive in smell, flows from the nostril. The swelling gradually increases in size, the discharge is augmented in its odor, difficulty in deglutition comes on, delirium follows, and the patient dies.

The discharge from the nostril is contagious and capable of reproducing the disease. Cloths moistened with it, therefore, should not be handled, and all contact with the dressings should be avoided on the part of the surgeon or nurse.

**Pathology.**—The pathology of the disease is no doubt that of blood poisoning. When post-mortem examinations have been made, no structures are found changed, except those immediately involved in the local affection, such as the mucous membrane of the nose, which is inflamed, and presents sometimes patches of ulceration, the latter involving the cartilages and even the bone itself. Metastatic abscesses in the kidneys, in the liver, and other glands have also been found.

**Treatment.**—The treatment of glanders in man is as follows: Evacuate the abscesses that form at an early period, and treat them like ordinary abscesses. Astringent injections into the nostril are also generally demanded, and especially those which are at once astringent and antiseptic, the latter being serviceable in correcting the fetid smell. Solutions of creosote and of the mild chlorides may likewise be used with this object. At the same time from twenty to thirty grains of quinine may be given daily, with six or eight grains of Vallet's mass, the diet consisting of a bottle of porter and a beef-

steak.    Though this plan is perhaps the best mode of treating the disease, it must be admitted that it frequently fails to effect a cure.

### § 6.—Malignant Pustule.

Another form of poisoned wound, in which the poison is obtained from diseased animals, is that known by European writers as malignant pustule, or the "Charbon" of the French.    In this case the mischief is the result of inoculation with fluids or other matters from the bodies of animals which have died from certain causes, as from being overdriven, or from being kept in close stables and improperly fed, as has happened in the cow stables of the suburbs of some of our large cities.

**Symptoms.**—In these cases, the individual who skins the animal may wound himself; or, without any wound, when immersing his hands in the fluids of the animal, or thrusting them under its skin, become conscious of an itching, burning, or tingling in one of his fingers, or in some part of the hand. A few hours afterward he notices a vesication at the spot where the sense of tingling was experienced, and by-and-by, the vesicle rupturing, a small amount of brown or bloody serum escapes.    Then follows the thickening of the part, a hard carbunculous tumor resulting which soon begins to slough, presenting the appearances of an ordinary moist slough, or the blackish and dried characters of an eschar, though the latter is less frequent than the moist form.

**Treatment.**—The treatment of Malignant Pustule is based upon the ordinary principles laid down in the case of carbuncle, to wit: to attend to the general health, and cauterize the parts freely with a stick of caustic potash, well rubbed in; or the actual cautery at a white heat may be employed, the object being to produce such a destruction of tissue as will leave a fresh and probably a healthy granulating surface when the slough comes away.

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# CHAPTER VII.

### GUNSHOT WOUNDS.

Under the general head of **Gunshot Wounds,** surgical writers usually describe all such injuries as are received in warfare, or which result in any manner from the explosion of gunpowder.    Gunshot wounds embrace, therefore, a very extended variety of injuries, and demand for their correct comprehension not only a knowledge of physics and the laws of projectiles in reference to their course and effects in the body, but also of special anatomy and physiology, in order that the position of the wound and its influence in modifying the normal function of any part may be understood.

The complete revolution in warfare recently effected by the increased range and power given to cannon and other fire-arms has rendered a modification of military tactics necessary.    The old fire of canister is not now as destructive to infantry as the Minié rifles.    Cavalry, at present, are in danger from rifles at a thousand yards; while Jacobs' experiment with rifled cannon "has demonstrated that a shot can be fired for six miles or more with force and accuracy."

The Armstrong gun will, it is said, throw a shell or shot five good miles, with wonderfully slight deviation. The Austrian carbine will, it is also reported, pierce three deal boards, each one inch thick, and placed one foot apart, at 1640 yards; and the Whitworth and short Enfield rifle can strike a small target at 1880 yards.

With these improved forces applied to projectiles, it might naturally be supposed that the surgical doctrines based on the experience of the wounds inflicted by the ancient weapons would also be much changed; yet the surgical observations made in the campaigns of Scott and Taylor, in Mexico, by our own surgeons, and those of the English and French, in the Crimea, under Raglan, Pelissier, and St. Arnaud, have not materially modified the great truths enunciated as characterizing gunshot wounds years since by Paré, Hennen, Larrey, Hunter, and Guthrie. With the exception of the difference in the extent of the injury made by a rifle-bullet and that of the old musket-ball in perforation, as well as the horrible laceration and disemboweling produced by shell and case shot, the general principles established during the wars of Napoleon I. yet stand in undimmed brightness as evidence of the correctness of scientific principles based on accurate observations.

Among the more recent contributions to the surgery of gunshot wounds, I would cite the following treatises, to which I am much indebted for many recent facts and details hereafter described.*

Of the general laws of gunshot wounds, long recognized as correct, the following have been verified pretty generally in the campaigns just alluded to :—

1. Gunshot wounds usually present evidence of contusion and laceration of the tissues injured ; hence more or less sloughing of their edges and track is to be expected.

2. Immediate or primary hemorrhage is less common in gunshot than in other wounds, unless some *large* vessel is freely exposed and cut ; and even then this does not always bleed, the application of a tourniquet being, according to Guthrie, "rarely necessary."

3. Consecutive or secondary hemorrhage is very apt to ensue in gunshot

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* Medical and Surgical Notes of the Campaigns in Mexico, during the years 1845, 1846, 1847, and 1848, by Jno. B. Porter, M.D., U. S. Army.

Diseases and Injuries of Seamen, etc., by G. R. B. Horner, M.D., U. S. Navy: Philadelphia, 1854.

Hints on Recruits, etc., by Thos. Henderson, M.D., U. S. Army, revised by Richard H. Coolidge, M.D., U. S. Army: Philadelphia. 1856.

La Guerre de la Crimée, par L. Baudens: Paris, 1858.

Histoire Medico-Chirurgicale de la Guerre de la Crimèe, par Adolph Armand: Paris, 1858.

On Penetrating Wounds of the Chest, by Patrick Frazer, M.D.: London, 1859.

Hand-book for the Military Surgeon, by Chas. S. Tripler, Surgeon U. S. Army, and George Blackman, M.D : Philadelphia, 1861.

Fractures of Bones occurring in Gunshot Injuries, by Louis Stromeyer, M.D.: Philadelphia, 1862.

Resection in Gunshot Injuries in the Schleswig-Holstein Campaign, by Friedrich Esmarch, M.D.: Philadelphia, 1862.

Notes on the Surgery of the War in the Crimea, with Remarks on the Treatment of Gunshot Wounds, by Geo. H. B. Macleod, M.D., F.R.C.S : London, 1858. Also American edition: Philadelphia, 1862.

Commentaries on the Surgery of the War in Portugal, Spain, France, and the Netherlands, by G. J. Guthrie. American edition: Philadelphia, 1862.

A Treatise on Gunshot Wounds, by T. Longmore Philadelphia edition. 1862.

The Ambulance Surgeon. or, Practical Observations on Gunshot Wounds, by T. W. Nunn and A. M. Edwards. Philadelphia edition, 1862.

wounds near large arteries, from the eighth to the twentieth day after the injury.

4. Gunshot wounds generally heal by granulation; rarely, if ever, by adhesive inflammation.

5. After hemorrhage, the greatest danger from gunshot wounds is the traumatic fever that is apt to attend the process of repair.

6. A certain constitutional alarm or shock follows every serious wound, the continuance of which is indicative of serious complications and dangerous consequences.

Like all general laws, the above are liable to occasional exceptions, which are not, however, so frequently seen as to invalidate their correctness. Thus, as to the first rule, when a wound is inflicted by a very rapid Minié ball in a healthy, temperate man, the wound will sometimes heal readily, and be otherwise amenable to the general laws of incised wounds.    So in connection with the second law, Macleod reports a soldier wounded at Inkerman, so as to open the great vessels of the neck, who was discharged cured in three weeks; while an artery, partially cut by a piece of a shell, was promptly fatal.

On the other hand, the younger Larrey cites a case seen at the siege of Antwerp, where a shell passed between a man's thighs and divided both femoral arteries, without hemorrhage, though the pulsation continued in the upper ends of the vessels to within a few lines of their extremities.    The speed of the ball at the moment it strikes the artery also influences the result—a rapid ball cutting the vessel so as to permit instantaneous hemorrhage, whereas a slower one contuses it, so as to prevent primary, though it favors secondary bleeding.    One of the peculiarities of gunshot wounds is the fact, that in persons wounded under the same circumstances, and apparently in precisely the same manner, the result of the wound is very apt to be entirely different; of which many cases are to be found in the works of Larrey, Guthrie, Macleod, Stromeyer, Esmarch, Longmore, and others.

Thus Larrey mentions a case in which two soldiers were wounded in the bladder, in the Austrian campaign, the ball passing completely through the body and coming out at the buttock; in one, the urine came through the wound in the back for the first twenty-four hours, after which it came through the natural channel.    In the other, with a precisely similar wound, the urine did not pass by its natural channel for twenty-one days, and a general infiltration of urine into the parts about the posterior orifice of the wound led to a troublesome sloughing, which confined him for several weeks afterward.    He also relates the case of a grenadier who was struck in the thigh with a five-pound shot, which remained in the thigh, covered by the muscles, its presence being recognized as he handled the limb, simply from its weight.    This limb being amputated, the man recovered without a bad symptom.    At the same time that the accident occurred to this man, his captain, standing near him, was struck with a similar shot from the same battery, the limb being entirely severed, though the injury did not extend so far up the limb as in the other case.    This thigh was also amputated, but the patient died.

Many cases illustrative of similar facts will be found detailed in almost all the works on military surgery, and no one can foretell the result of an apparently simple gunshot wound, or the duration of its treatment.

The character of the wound made by slow and fast ball, at long distances, varies much.    A **round bullet**, at *short range* and at speed, wounds like a *knife*, and perforates a bone without splintering it; while a *slow* and *distant* ball lacerates the flesh and splinters the bone.    The **conical bullet**, especially from Minié rifles, having much greater velocity, cuts cleaner, at short range,

than a round, swift bullet; while at long range (and its range is very great) it tears more than a slow, round one. A round bullet may glance from a bone or be split on its edge, as on the tibia; a conical one seldom if ever splits, and invariably, as proved in the Crimea, splinters the bone struck in the direction of its axis, leaving spiculæ to discharge for months subsequently. Macleod states he never met with a case in which a conical bullet, at any range, that struck at all perpendicularly to a bone, failed to traverse and comminute it extensively. Longmore remarks* that the wedge-like shape of the conical bullet is particularly obvious on its being driven into the shafts of the long bones, the osseous texture being split up into fragments in a direction mainly parallel to the central cavity, fissures not unfrequently extending into the termination of the bone in the joint, these results being rarely if ever noticed from round bullets.

The severity of gunshot wounds depends less upon the character and size of the projectile than upon its velocity; hence the conical bullet, like that from the Minié rifle, is more destructive than a round one. It is important, however, in this connection, to study the general laws of projectiles as well as the effects they produce upon contact with the body. The following, which have been laid down by the most experienced military surgeons, are generally received as correct:—

Laws of Projectiles.—1. The greater the velocity of the ball, the greater will be the danger to life.

2. The swifter the ball, the more direct will be its course through the part. Hence the greater danger of wounds of important viscera from balls received at close quarters.

3. The slower the movement of a round ball, the more apt it will be to splinter a bone which it has struck, a swift ball being much more apt to cut a bone clearly.

4. Free and primary hemorrhage is more frequent from wounds made by swift than from those made by slow balls, the latter being mostly followed by secondary hemorrhage.

5. If a slow, round ball strikes a bone without sufficient force to splinter it, it is apt to flatten upon it; while a swift, round ball, striking against a sharp angle of bone, will often be split into two fragments, each of which may pursue a separate course.

But according to the experience of Macleod,† "the greater velocity, peculiar shape, and motion of the conical or Minié rifle ball, will give to its wounds a character considerably different from those just alluded to, as caused by the old round musket-bullet. Thus, at a short range, the Minié ball produces less laceration of the soft parts than the old ball, but if the range be great and the part struck bony, with little covering of flesh, then the tearing, especially at the point of exit of the Minié ball, will be much more marked."

The injury created by Minié balls, fired at short or long distances, he also says, varies considerably; one from a short range, passing at speed, inflicting wounds of the soft tissues similar to those caused by a knife, and perforating a bone without splintering it, as a slower ball is apt to do. Wounds created by conical balls, like those from the Minié rifle, have usually greater velocity than the old bullet, and, therefore, if fired at short range, lacerate the soft tissues less than a round bullet; but if at a long range, tear more than the old bullet. When a bone is struck by a round bullet the ball may glance off or be split into two or more fragments, or flattened and buried in the part; but this is not the case with the conical ball or slug. This the Crimean surgeons seldom found split, while it invariably splintered the bone which it

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* Op. cit., p. 17.           † Op. cit., p. 101, Phila. edit.

struck in the direction of its axis.    Macleod therefore states* that he never met with a case in which a conical bullet, at any range, that struck at all perpendicularly to a long bone, failed to traverse and comminute it extensively.

After thus noting some of the changes created by the introduction of rifled arms, we may next advantageously examine the effects of projectiles, or their action upon the soft tissues of the body.

A ball penetrating the soft tissues always produces a contused wound, this result following irrespective of its velocity, because when a ball passes from the air into the flesh, it passes from a rarer to a denser medium, and experiences resistance at the point of entrance; hence the contusion in gunshot wounds is always more marked at the point of entrance than at that of the exit of the ball.    This difference of character between the wound made by a ball in entering and that left by it in quitting the body is not unfrequently of importance in a medico-legal point of view, and its distinguishing characters, as generally admitted, are therefore of some interest.

The opening made by the entrance of a round or musket ball is contused upon the edges, while the orifice is small, often smaller indeed than the ball itself, in consequence of the contraction of the surrounding structure, the latter being also sometimes more or less depressed from without inward.    The edges of the wound are, also, bluish or livid in their color, from the exudation of blood beneath the skin, and not, as was once thought, from the stain of gunpowder or the *poisonous* character of the missile.

When a ball escapes from the soft parts it passes from a denser into a rarer medium; the skin is consequently stretched at its point of exit from within outward, and the parts are therefore more or less lacerated, though they are not so much disposed to slough as those at the wound of entrance. The orifice of exit is usually as large as, often larger than, the ball itself. The slough at the centre of the point struck is usually equal to the circumference of the ball, while that at the point of exit is more apt to be in shreds.

In studying the appearances of wounds made by all bullets, Macleod, however, states† that he has not been able to satisfy himself in all cases of the distinguishing characteristics of the wound of entrance and exit as clearly as the description of authors might lead one to suppose.    The wound of entrance, he admits, is in many cases more regular and less discolored than that of exit, but he has seldom found that its lips were inverted, while those of exit were everted.    If the speed of the ball is great and no bone is struck, then he thinks there is little difference in either the size or discoloration of the wounds; "but if the flight of the projectile be so far spent as to be retarded by contact with the body, especially if it has encountered a bone or aponeurosis, so that its speed is considerably diminished before it passes out of the body, then the wound of exit will considerably exceed in size that of entrance, and this is especially true of conical balls.    If, on the contrary, a ball be fired close at hand, so that its speed is not sensibly diminished by its passage through a limb, then the difference of size will be very small, and may even be in favor of the wound of entrance."

Guthrie, in connection with this general statement, remarks‡ that "the wound of entrance of a musket-ball is usually circular, depressed, and capable of admitting the little finger—that of exit being more ragged, and not depressed."

This question of the external appearance of wounds from balls, though carefully studied by military and civil surgeons, must, however, be admitted

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to be unsettled, the distance at which the shot is fired greatly modifying the appearances. Begin's observation, in reference to the resulting cicatrices, is probably the surest mode of deciding the question in cases that recover, to wit: "That the cicatrix of the wound of entrance is usually white, depressed, and adherent to subjacent parts, while that of exit is only an irregular spot that is not adherent." As the cases that die are, however, those mainly interesting in a medico-legal light, this test is not often available. In the case of a fireman, shot in Philadelphia in a street fight, and taken to the St. Joseph's Hospital, in 1857, the ball had apparently entered the abdomen and come out at the spine, though the man's dying statement was the reverse, and no decision could be safely given, even after a cautious post-mortem examination by myself and others. Hunter and Hugier both agree in stating that a small plug of integument is carried into the wound, and may be often found in the track of the ball; but such was not seen in this man, though I carefully sought it. When found, its presence would materially aid the decision of this vexed question.

Baudens says* that bullet wounds differ according to the swiftness and form of the projectile. The wound of entrance of a *conical ball* is, he thinks, generally rounded, depressed, and smaller than the wound of exit, while the track which it makes in the thickness of a limb has the shape of a cone, which continues to increase. If the ball meets an aponeurosis or bone its deviation is marked, and it is not rare to find that the wound of exit is more irregular and contused, and the edges more raised and thrust outward, than the wound of entrance. The wound of entrance of a conical ball is, he says, oval or linear, as if made by the point of a sabre, the wound received in the groin by General Thomas at the Alma being entirely analogous to that of a cutting instrument. The track of a conical ball wound is also of the shape of an elongated cone, this being doubtless due to the arrow-like or rotatory movement which it executes. Its track is likewise less deviating than that made by a round ball.

In numerous instances that have come under my own observation, during service with Pennsylvania troops exposed to accidents from arms in the hands of raw recruits, gunshot wounds were common. In most of these the wound of entrance ultimately exhibited a marked slough, this extending some distance along the track of the ball. In some cases this slough presented the appearance of concentric circles, as described by Sir Charles Bell, extending, by a prolonged tube-like process, into the track. The concentric sloughs indicated in a marked manner the violence of the contusion, the centre or focus being the deepest, and marking the point of entrance; outside of this was a less marked slough, and outside of this another, recalling the appearance of circles made by dropping a stone into a placid lake.

**Course of Balls.**—The course of gunshot wounds is exceedingly variable, and can never be accurately foretold; thus balls may enter the body, and, after traveling for some distance, come out again from the opening by which they entered, as in the case cited by Hennen, in which a ball struck upon the pomum Adami, traversed the neck, came out and lay where it entered. When a ball passes through the body it also does not always do so in a straight line, but it may be deflected by an aponeurosis, cartilage, bone, or even a rigidly contracted muscle. Armand cites the case of a captain in the Crimea, wounded in the shoulder, without showing any sign of the exit of the ball, which, after a careful examination, was found to have struck the scapula, been deflected, traversed the vertebral gutter, and was found as a prominence on the loins, whence it was extracted.

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* Baudens, p. 114.

Sometimes two openings are made by but one ball, a result occasionally due to its being split, and the fragments flying in different directions, or from its escaping at one point and entering another, as when a man shot in the shoulder with his arm raised, has also been wounded in the head by the exit from the arm of the same ball, instances of which are described.

In searching for a ball, it is important, therefore, to place the patient as nearly as possible in the position he occupied when struck : thus, if he received a ball in the shoulder while in the act of firing his piece, with the arm up, the arm should be raised to a similar posture in searching for the ball.   So, also, if struck in the thigh while on horseback, the leg and thigh should be placed as nearly as possible in a similar attitude, when the ball is sought.   Various cases may be cited to show how devious the course of a ball will sometimes be.   Thus in one case, cited by Hennen, a man in the act of mounting a scaling-ladder was struck by a ball in the head, and it came out at the shoulder.   In another the ball struck on the calf of the leg, and came out at the popliteal space.

Similar instances are also occasionally seen in civil service : thus an individual being a little love-sick made an attempt to commit suicide, by discharging a pistol against his heart ; but the ball passed along the course of a rib to the spine, down which it went to the pelvis, and I took it out at his buttock. So also the case of a blacksmith who put a gun-barrel, which he did not know to be loaded, into a fire to heat it, when the piece went off and the ball which it contained struck upon his leather apron, over the belly, penetrated the apron, clothes, and skin, followed round the course of the external oblique muscles of his abdomen, and was taken out by me beneath his scapula.

These facts show that when a ball enters the body on one side, and makes its exit on the other, it by no means follows that it has passed directly through it in a straight line.

When the ball is so situated that it can be felt there is no difficulty in recognizing its position, but this is not always the case, and the evidence of the presence of a ball is often very slight, though it is certainly present.

Thus Macleod cites* the case of a man wounded at the Alma by a piece of shell weighing nearly three pounds, which, after being overlooked for two months, and creating only a small fistula, was extracted at the hospital at Scutari.   Hennen also mentions an officer wounded at Seringapatam by a 12-pound shot, that remained unobserved for some time, though buried in his thigh.   Great care is therefore demanded in the primary examination of gunshot wounds.

As regards the removal of balls, the above facts give an important rule in the treatment of gunshot wounds, viz., that if the ball cannot readily be extracted without increasing the risk of hemorrhage, or doing injury to the bone, as denuding it of periosteum, etc., it is better to allow it to remain. The same rule holds good in regard to the soft parts—if the ball cannot be gotten at without risk of opening arteries, wounding nerves, or doing other serious injury, it is better to let it alone.   An instance of the length of time during which a ball may remain imbedded without creating marked inconvenience was presented to me, some years ago, in an officer of the war of 1812, who carried a ball imbedded in his sternum until 1843, when, accidentally striking his breast rather violently, a little tumefaction was produced which suppurated, and, when the abscess was evacuated, the ball was thrown off with the pus.

Many similar cases are everywhere to be noted in the records of sur-

* Op. citat., p. 104.   Philada. edit.

gery, and in almost every section of the world individuals can be found who have carried balls, received in various ways, for a longer or shorter period. But though balls frequently remain safely imbedded in bone without creating marked inconvenience, it is particularly in connection with the injuries produced in the bones by balls, that gunshot wounds are of so serious a character, and especially those made by the conical or Minié rifle balls—"these almost invariably splintering the bone against which they strike to a greater or less degree. The round ball fractures the bone with but little comminution, but the conical ball splits and rends the bone so extensively that narrow fragments, many inches in length, are detached, and lesser portions are thrown in all directions, crosswise at the seat of fracture, and driven in the adjacent soft parts."*

The extended experience of surgeons, since the discovery of gunpowder, might at first be thought to have left but few points of practice unsettled; yet there has been much difference of opinion among civil and military surgeons in respect to the propriety of extracting a ball, if it can be done with safety to life. In this question experience alone can guide us, and this, I think, settles the practice in favor of its removal in every case in which it is possible to accomplish it. Malgaigne regards the cases—of which every surgeon knows numerous examples—in which balls have remained a long period without apparently doing harm as only evidence of the resources of nature, and not as militating against the indication "to extract them."

Macleod† states that the removal of the ball, when at all possible, is of the first importance, "knowing how great is the irritation caused by the presence of a foreign body, how restless and irritable the patient is until it is removed, and how prolonged the period of treatment where it is left."

Huten reports that of 4000 men examined by him in five years, there were only 12 who reported themselves as suffering no inconvenience from unextracted balls, the wounds of 200 continuing to close and open until the foreign body was extracted. Although "lead acts very kindly," and there are cases in which encysted balls have caused little trouble, these cases must not be allowed to influence the general precept of always extracting all foreign substances, in gunshot wounds, when it can be done without involving large blood-vessels or nerves, or opening joints.

**Wind of Balls.**—Patients exposed to large projectiles, such as cannon-balls, etc., sometimes give evidences of serious injury, although it is impossible to find any external wound; and these injuries were, therefore, formerly supposed to be due to a commotion of the atmosphere caused by the near approach of the missile to the patient's body, or, in common language, to the wind of the ball. As science progressed and electricity began to attract attention, it was thought by some that the injury was due to an electrical change in the parts, produced by the presence of a large, moving, metallic body, this being capable of drawing off the electricity from the part, and thus developing a force from the body to the ball. At present, however, both these opinions are rejected as untenable, the symptoms in question being generally, and doubtless correctly, attributed to the contact of passing spent balls, or more frequently to the lateral concussion and contusion produced by the revolution of any ball on its own axis, as it glances rapidly by the person injured.

Baron Larrey, in alluding to these injuries, regarded the effect produced as being the result of the ball, as shot from a gun, being acted upon by two forces— that of the powder propelling it forward, and that of gravitation drawing it toward the earth, and in consequence of this double action it rolled obliquely

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* Macleod, p. 107  Philada. edit.     † Op citat., p 112, et supra.

over the part injured. This double motion can be readily demonstrated on the Gyroscope. Every ball fired does not move in a right line, but takes a parabolic curve, and acquires a rotatory motion upon its own axis as it leaves the gun and progresses to the object; then, having nearly lost its original propelling force, and rotating in the manner described, it injures the part touched in the same manner as would the wheel of a heavy vehicle. The wounds inflicted by the so-called wind of balls are then really instances of injuries caused by the grazing of large shot. In the case of a woman injured on the abdomen, by a large shell, fired at the arsenal near Philadelphia, in testing the quality of powder, there was rupture of the spleen, and free internal hemorrhage that caused death, yet the abdominal walls gave no evidence of contusion.

Macleod* also relates the case of a man certainly hit by a round shot, at Sadoolapore, on the outer side of the arm and thorax, where no mark was visible, yet who died in twenty-four hours without having rallied from the shock—the post-mortem examination showing the cavity of the peritoneum filled with dark blood, the right lobe of the liver torn into small pieces, some of which were mixed with the blood, though the other viscera were healthy and there was no sign of peritonitis. The injuries of soft parts by the so-called wind of balls must then be regarded as true cases of contusion. In cases where the soft parts are supported by the hard tissues, the severe blows of passing balls near the head are not, however, followed by similar results, Guthrie† distinctly stating that he has seen the skin injured in various parts of the head and neck by the direct contact of a ball, without its causing any other inconvenience than that of the external wound.

**Appearance.**—Gunshot wounds usually present a more or less livid surface, the borders of which are dry, the adjacent parts being more or less ecchymosed in the track of the ball, and either violet or brownish red, if superficial.

**Symptoms.**—The symptoms of gunshot wounds are both local and constitutional, each being often highly dangerous to life—the local immediately so, the constitutional more remotely.

The **Local Symptoms** of gunshot wounds vary greatly in accordance with the size and character of the projectile, the distance at which it is fired, as well as with the character of the part injured. They may therefore be studied under the head of local disturbance of Sensation and Circulation, or Pain, Hemorrhage, and Inflammation.

**Pain.**—In bullet wounds of a fleshy part, the sensation of being shot is usually described by the patient as being similar to the effect of a sharp blow with a stick or stone. If a sentient nerve is injured, the sensation is often compared to the stinging or burning pain of a hot instrument, while, if a bone is splintered, the pain is more acute. Larger projectiles do not appear to cause as acute pain at the moment as might at first be supposed, from the extent of the injury they induce, entire limbs, as stated by Hennen and other military surgeons, having been shot away by cannon-balls, without entailing direct suffering, while large grape-shot, weighing two pounds, or a piece of shell having been imbedded in the fleshy part of the thigh without the patient complaining seriously, or even, indeed, being aware of their presence.

Cases illustrative of these facts are sufficiently numerous. Thus Macleod‡ states the case of an officer who had both legs carried away, who said it was only when he attempted to rise that he became aware of the injury he had received. Larrey also reports having extracted from the thigh of a

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* Op. citat., p. 121. Phila. edit.          † Injuries of the head, p. 155.
‡ Op. citat.

soldier a ball weighing *five* pounds, which had not been detected by the surgeon, and of the presence of which the patient was not conscious, except from an increased weight of his limb.

Hennen likewise reports a shot of *twelve* pounds, and Baudens, a fragment of a shell weighing over *five* pounds, that was so completely buried in the thigh as to be almost invisible—the elasticity of the soft tissues probably closing the opening by which the mass entered the limb.

**Hemorrhage.**—The hemorrhage from gunshot wounds is usually small, in proportion to the extent of surface injured, except in very vascular regions, as the back and neck, where, as Guthrie has observed, blood often flows freely, though no large vessel has been injured. When a main arterial trunk is entirely divided, the primary hemorrhage is often not so marked as in partial division of the vessel, or on the consecutive hemorrhage supervening on the sloughing of an injured vessel.

**Inflammation.**—The loss of sensation that often supervenes in gunshot wounds is liable to be followed in three or more days by a reaction which creates inflammatory action, and then the wound presents evidence of local irritation that is not unfrequently either the precursor or sequence of the development of constitutional disturbances. In these cases the parts adjacent to the track of the ball, and especially the outer portion of the concentric circles before alluded to, swell so as to render it difficult to trace its course, while the entrance of air creates emphysema or an infiltration of the areolar tissue which induces crackling on pressure with the finger.

The **Constitutional Symptoms** of gunshot wounds may be noted either immediately after the occurrence of the injury or more remotely, in numerous instances being indicative of general nervous disturbances, creating a condition which has been already described under the general head of Shock of Injury. But occasionally the local injury develops a local shock as well as the constitutional disturbance before alluded to, the patient, especially when a bone is splintered, or a large vessel or nerve torn, experiencing a sense of heaviness and local weight which is soon followed by general debility, the face becoming pale, the muscles quivering as with a rigor, with a marked sense of oppression at the precordial region, that is sometimes followed by vomiting and hiccough. This is the lighter form of shock as noted in other injuries. At other times the patient appears too calm to be natural, as in the case described by Armand,* where a sergeant, who had his thigh traversed by a ball and the bone splintered, was operated on for the removal of the limb, and though losing little or no blood, sank into a syncope, in which he died. This corresponds with the insidious or secondary shock before described.

After the symptoms of collapse and irregular nervous action subside, there is usually, in even bullet wounds, a reaction—the more persistent effect of the injury being noticeable about the second or third day subsequently, in the general disturbance of function developing fever of the irritative or traumatic variety, or one which assumes during the reparative process the well-marked traits of hectic, as before alluded to.

The primary constitutional symptoms, in addition to those of the nervous system, described as the result of shock, are: paleness, yellowness or lividity of the face, which often extends to the entire body, a feeble pulse, faintness, trembling or irregular muscular action, with depression of spirits or despondency. These symptoms vary considerably in their period of development and duration, being more or less marked in accordance with the extent and nature of the wound, the exhaustion due to excessive fatigue, want

* Op. citat., p. 125.

of food and drink, and the various emotions excited in battle, as well as the vital character of the region in which the wound is created, and the hemorrhage. When a bone is broken or large nerves are torn, especially in a patient of an excitable temperament, there is often noticed a general stupidity and sense of extreme languor, with oppression at the heart and epigastric region, cold surface, especially of the extremities, and sometimes a general shaking, as if from extreme trepidation; vomiting also often supervenes, with feebleness of pulse, and hiccough—as before alluded to—and which it is difficult to arrest until reaction sets in. This has been often noted, and was particularly marked in the case of private Welsh, who had both his forearms shot off by the premature explosion of a cannon, at Camp Curtin, Pennsylvania. After the lapse of two or three days, these symptoms pass away, the evidence of inflammatory action, as indicated under other circumstances by the frequency of the pulse, heat and dryness of the skin, constipation, etc., supervening and continuing until the reparative effort is fully established.

In addition to the local and general symptoms just enumerated, gunshot wounds often present suppression of suppuration, unhealthy and indolent ulcerations, hospital gangrene, great exhaustion of all the powers of life, as in marasmus, with wasting of the muscles of a limb, stiffness of a joint, long-delayed exfoliation of a bone, fistulous sores, and irregular or vicious cicatrices.

Splinters of wood or stone, struck off by balls or fragments of shell, create a class of wounds that come rather under the head of lacerated than of contused wounds, as they present the torn edge, absence of hemorrhage, and difficulty of union of the former class of wounds. Should the fragments of stone or shell present sharp-cutting edges, ordinary incised wounds may be produced. Many of the terrible wounds due to shells thrown at close quarters at Sebastopol, disemboweling patients and tearing off limbs, were reported as being of this class, the wounds resembling those made by a sharp-cutting instrument, and inducing rapid and fatal hemorrhage.

**Diagnosis.**—The diagnosis of gunshot wounds is usually easy, if a correct history can be obtained.

**Prognosis.**—The prognosis in all cases of gunshot wounds is serious until after suppuration has ceased, for, in the most trifling wound, erysipelas may be developed at any moment, or hectic or inflammatory fever set in, and carry off the patient during the suppuration of the wound. The surgeon should, therefore, be guarded in expressing an opinion respecting the duration or result of all gunshot wounds.

**Complications.**—The various *complications* of gunshot wounds require separate consideration.

1. The first and most common of these is that resulting from the presence of foreign bodies in the wound, such as substances driven in by the ball, or broken off by it in its course, as small pieces of clothing, buttons, bits of the leaves of books carried in the pocket, and fragments of bone near the wound.

2. The second complication arises from inflammation; and this, in a wound otherwise doing well, may originate from the most trifling excesses in diet, drink, exercise, or venereal indulgence, cases being on record in which officers and others who had very nearly recovered from severe wounds or amputation, died, nevertheless, from hemorrhage brought on by want of caution in these particulars. Changes of temperature alone may induce serious complications, and heat, dampness, or cold may cause trouble by modifying the inflammatory action. Free suppuration frequently complicates these wounds, the pus traveling among the muscles and pro-

ducing finally a disposition to adhesions, which results in stiffness of the limb, or anchylosis, if joints are involved in the injury.

3. The third complication is secondary hemorrhage, which may ensue upon a gunshot wound : first, from excessive arterial action, however excited ; second, from sloughing ; third, from a want of proper tone in the granulations; and in all these instances nothing but an arrest of the hemorrhage will save the patient.

4. **Tetanus,** which will be treated in full hereafter.

**Treatment.**—The indications for the treatment are :—

1. To examine the wound carefully and promptly—carefully, so as to make sure of the removal of all foreign bodies; and promptly, lest the swelling which supervenes in the injured tissues should interfere with the accuracy of the examination.

2. To remove promptly the ball and all foreign matters, such as clothing, splinters, etc.

3. To moderate the inflammatory action.

4. To facilitate the escape of pus by every means, such as position, etc.

5. To favor the separation of the slough.

6. To guard against secondary hemorrhage.

The means of fulfilling these indications are as follows :—

1. In the examination of the wound, the finger or a female catheter should be used, if possible, or a probe if these cannot.  The probe should be a flexible silver probe, of sufficient length to reach at least fifteen inches.  This, for convenience of carrying, may be made of two pieces, arranged so as to screw together.  If the wound is shallow and straight in its course, the ordinary probe of the pocket-case may answer.  In searching for a ball, the part should be placed, as far as possible, in the position in which it was when struck, so that the contraction of muscles, etc. may not create an obstacle in following the track of the ball; hence, if an arm is wounded while extended or elevated, or a leg while the foot was flexed, and either was examined under different circumstances, the surgeon might be misled.  The eccentric course often taken by balls should also be recollected during the examination, a ball often glancing and pursuing a different course, in consequence of its impinging on a bone, tendon, or thick aponeurosis.  All the works on military surgery contain numerous examples illustrative of these points.  In searching for a ball, valuable aid may be obtained from the employment of an **Anæsthetic,** this inducing such perfect muscular relaxation as renders the question of the position of the part when struck of but little importance, while the extraction of the ball will be greatly facilitated.

2. The ball·being found, the next indication is to remove it, which may be accomplished in various ways.  If the bullet, after having penetrated some distance, is lodged immediately beneath the skin, the simplest manner of removing it is to make an incision upon the ball through the skin, this being designated as a "counter-opening," and through this it may readily be extracted.  While making the incision, the ball should be fixed by pressure with two fingers, and any little filaments of fascia which may remain be clipped off with the scissors, rather than with the knife, lest the rotundity of the ball should cause the edge to slip and other parts to be wounded. In employing the knife for making incisions in the extraction of balls, Guthrie recommends that the surgeon's hand should be unsupported, in order to prevent accident from any sudden motion of the patient or those around him, on the field of battle, and during an alarm.

To remove a ball by extraction through the opening made by itself, various instruments have been contrived.  Such are the Tierballe, which consists of a rod of steel, with a screw at one end, which is screwed into the soft lead

of the ball, and traction then made on it. This instrument is said to be particularly useful in extracting balls imbedded in bone; but in various experiments that I have made with it I have found it worthless. At the opposite end of the instrument is a scoop, (curette,) by means of which, and with the aid of the finger, a ball may sometimes be readily removed. A pair of small forceps, resembling the polypus forceps of the dressing-cases, with small fenestra, is useful in cases where the ball has not penetrated too deeply, or for the extraction of shot; and the long gunshot forceps, made after the pattern of Percy's forceps, so that they can be opened without dilating the orifice of the wound, are much used.
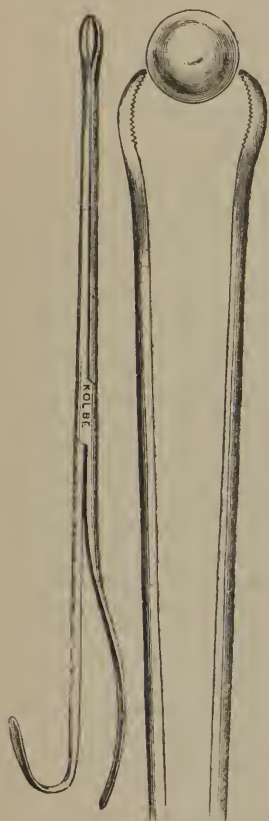
Fig. 196.                                    Fig. 197.
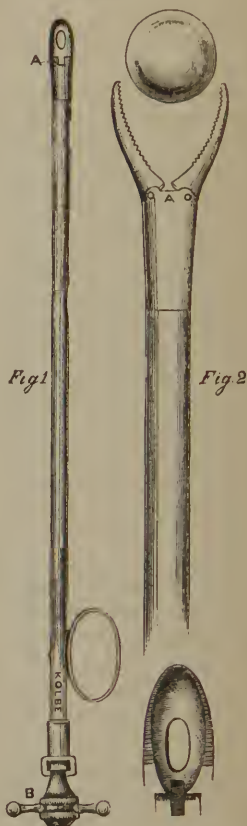


An instrument is also made in which the two blades of the forceps fit into each other like a single scoop, and so enter the wound, when, a proper depth having been reached, one blade is made to rotate upon the other, thus converting the instrument into a pair of forceps which seizes the ball, Fig. 196.

An instrument has likewise been used similar to that employed by Civiale —litholabe or three-pronged clasp—for crushing stones in the bladder. Having reached the ball with this, a screw in the handle expands the blades and separates the soft parts, when the reverse action of the screw enables the prongs to grasp the ball, which, being firmly seized, may then be extracted, Fig. 167, *fig* 2. An instrument similar to Leroy d'Etiolles' scoop,

for extracting fragments of stone lodged in the urethra, is also sometimes useful, Fig. 197, *fig.* 1. This instrument is passed down by the side of and beyond the ball, when the action of a screw in the handle bends a joint at the end of the instrument, at right angles behind the ball, which is thus readily extracted by traction upon the instrument.

Fig. 198.
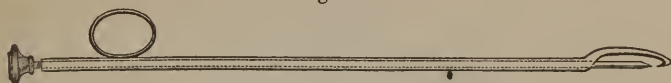


An instrument recommended by Erichsen, of London, for the removal of conical balls, is represented in Fig. 198. Experiments on the dead body have not, however, given me a satisfactory result. Indeed, more will depend on the judgment and practical skill of the surgeon than on the mechanical form of any extracting instrument.

3. In all attempts at moderating inflammatory action general principles must be observed, as already laid down under the subject of Inflammation.

In combating the violent local action that supervenes on gunshot injuries, it is generally admitted that the tepid or cool water-dressing is the cleanest, purest, and most useful, though it must be cautiously employed in wards containing inflammatory disorders. The question of the temperature best adapted to the prevention of inflammatory action in these wounds and the use of water-dressings, has already given rise to a considerable diversity of sentiment. Begin* regards fresh and cool water cloths as most desirable.

Baudens thinks the use of ice most precious, and has found his patients always to do well under its use as long as there existed any unhealthy degree of heat.

Hugier limits the employment of cold irrigation to those wounds whose extent and depth could be refreshed by its action, or to those threatened with extended suppurations beneath fasciæ.

Roux opposed cold water lest it should check the inflammatory action by which nature was to cure the disorder.

Velpeau inclines to a similar opinion; while Amussat prefers tepid to cold water.

Armand, in the Crimean hospitals, rejected cold fomentations for general use, on account of the moist atmosphere that they created, applying only a little spread cerate, etc. The result of this practice was, he says, ten deaths out of 280 patients. Although, then, the water-dressing has some advantages, yet we must not forget the tendency of a moist atmosphere to favor the production of infection, nor overlook the fact that a certain amount of inflammation and suppuration is necessary for the cure of gunshot wounds.

4. The modes by which it will be best to attempt to favor the escape of pus depend much upon the nature of the wound. Sometimes free incisions will be necessary, so as to lay open fascia beneath which the pus is collecting; and sometimes all that is required can be obtained by attention to a proper position.

But it is a well-settled point that it is unnecessary to employ a tent to dilate the orifice of a wound, or to slit open the track of a ball, when its course is such as to permit it. This question of the "unbridling" of a wound to favor the exit of pus and the sound healing of the parts has been ably discussed by the French surgeons, most of whom regard the practice as an injurious one. Roux and Beau favored it; but Velpeau, Malgaigne, Jobert,

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* Armand, p. 158.

and Baudens opposed it as injurious, and this opinion has been sustained by the experience of the surgeons who served in the Crimea.

5. The separation of the slough may be favored by stimulating the natural action, by washes, etc., as directed in the treatment of gangrene. As parts of the slough loosen, they may be clipped off with scissors; but traction upon a slough that is attached to any point should seldom or never be made, on account of the risk of secondary hemorrhage.

6. The last indication in the treatment is in reference to the secondary hemorrhage, and this can generally be arrested by compression, except where large vessels are involved. In case such vessels are pouring forth blood, it will be necessary to cut down upon the sound portion of the main trunk of the vessel above the wound and tie it. But the hemorrhage which usually gives the most trouble is that oozing from the surface, which escapes from vessels that cannot be seen, and which pressure often fails to arrest, probably, in some cases, from want of attention to its proper application, as the following plan has often checked it : Interrupt partially the course of the general circulation near the wound by means of the ring tourniquet, or Bellingham's compressor, or some such means; then, having sponged the wound clean, and turned out any clots that have collected there, introduce into it portions of patent lint, of charpie, or of agaric, and pack them neatly and closely together. Then, covering the whole with a graduated compress, make pressure upon the part by means of a bandage, accurately applied and extending some distance above the wound.

Sometimes, in wounds received at close quarters from weapons loaded with small shot, the entire load enters without scattering to any extent ; or the charge, wrapped in its wad, remains in the wound, so that the whole may be extracted together. Such instances not unfrequently occur in the case of sportsmen, shot by the accidental discharge of their fowling pieces while in the act of leaping a fence, etc.; and more than one such has thus come under my observation. In all these cases every reasonable effort should be made to extract all the foreign substances. When shot are imbedded beneath the skin, their extraction will save the patient the bluish discoloration which they generally cause if allowed to remain, and their extraction requires only a skin puncture. The removal of grains of powder has been alluded to under the head of Burns, p. 421.

**Amputation.**—With regard to the question of amputation in gunshot wounds, the rules of civil and of military surgery differ, it being proper to amputate limbs in military service which a surgeon in civil practice would attempt to save ; primary amputations, or those within thirty-six hours after the injury, being also preferred in military surgery, while in civil surgery those performed at a later period seem to do best. In military service, primary operations are generally most beneficial because performed on the field, the patient being then in fair health, and thus saved the irritation that would ensue upon the transportation of a broken bone, etc. to a distant hospital.

Armand,[*] in referring to this question of the advantages of primary over secondary amputation, in the treatment of gunshot injuries, in the Crimea, reports 30 cases of immediate or primary amputation, in which 18 were cured, 10 died, and 2 were under treatment, with excellent prospects of recovery; while in all the amputations and operations secondarily performed in his service, the mortality reached the fearful proportion of seven out of nine—to wit, 4 cases of amputation of the arm, 1 disarticulation of the shoulder, 1 resection of the head of the humerus, 1 amputation of toes; all of which

* Armand, Guerre de la Crimée. p. 155.

died—1 of toes, and 1 of the leg recovered. By referring to the general question of amputation, as stated in vol. ii. in connection with the operative proceedings, the results of civil practice will be noted.

Guthrie, whose experience renders his opinion almost indisputable, says: "Amputation of a limb is the last resource and the opprobrium of surgery, as death is of the practice of physic; it being, notwithstanding, impossible to do impossibilities, and save a life or limb which can no longer be preserved, art and science at that point cease to be useful.

" When the wound of an extremity is of so serious a nature as to preclude all hope of saving it by scientific treatment, it should be amputated as soon as possible.

"An amputation *of the upper extremity* may almost always be done from the shoulder-joint downward without much risk to life; when necessary, the sooner it is done the better.

"An amputation of any part *of the lower extremity* below the knee may be done forthwith with nearly an equal chance of freedom from any immediate danger, as of the upper extremity at or near the shoulder-joint.

" It is otherwise with amputations above the middle of the thigh and up to the hip-joint; they are always attended with considerable danger."

The use of anæsthetics is thought by many of the more modern surgical authorities to diminish the mortality of amputations either in military or civil practice.

**Summary.**—The summary of the principles adapted to the general operative treatment of gunshot wounds, as furnished by Armand* as the result of his Crimean experience with the ambulances of the French Imperial Guard, is so condensed and sound that I herewith translate it.

" 1. In field hospitals (ambulances) it is best to seize the operative indications, and operate without hesitation in the hours that immediately succeed a battle, rather than wait for a secondary amputation, as this is nearly always fatal. This rule is not applicable to wounds that demand amputation above the middle of the thigh, the great mortality of this operation favoring a delay in the majority of cases.

"2. Laying open (unbridling) the course of a ball—even where it is probable that pus will accumulate below a fascia—ought to be rejected, except in cases of gangrene.

"3. Cold water-dressing ought not to be employed in a general way when there are many cases of gunshot wounds in the same wards.

"4. The abstraction of blood by leeches, in order to prevent inflammatory action before it becomes serious, is useless or even injurious in the field, where the men are always more or less exhausted by fatigue and the privations of war.

"5. In the ambulances, complicated wounds should be immediately rendered simple by seeking for and extracting splinters and foreign bodies. In hospitals, on the contrary, and when the period of suppuration arrives, these examinations should be very cautiously attempted—suppuration aided by position and emollient injections being sufficient to remove projectiles and bony fragments."

Another complication of gunshot wounds, and a serious one, is that of Tetanus, which we may next investigate in its general bearings.

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* Armand, Histoire de Guerre de la Crimèe, p. 161.

# CHAPTER VIII.

## TETANUS.

**Tetanus**—from τεινω, to stretch—is a nervous disorder characterized by spasms, (from σπαω, to draw.) It is recognized by the fact that it presents tonic rather than clonic contractions of the muscles, and has already been alluded to as one of the most serious complications of gunshot wounds, though often following punctured, lacerated, and other wounds involving nerves and fasciæ.

Tetanus is called Idiopathic where it is dependent upon constitutional causes, such as exposure to cold, the presence of irritating ingesta, etc. It is called Traumatic when it arises from wounds.

**Symptoms.**—The symptoms of traumatic tetanus are as follows: There is first, at a period which varies greatly after the reception of a wound, a soreness in the muscles of the jaw, which feel as if the patient had been eating something hard and was tired. This stiffness soon spreads to the muscles of the neck, producing the sensations of stiff neck, or such as is caused by a draught of cold air, and often described in this way by the patient. A peculiar expression of countenance is then soon observable, which may be characterized as a painful smile, and is due to the fixed contraction of the zygomatic muscles. At the same time the eyes have a peculiar look; they stare, and are gathered at the corners by contraction of the orbicularis palpebrarum. The affection of the muscles of mastication soon becoming more marked, the masseter contracts so powerfully that the jaws cannot be opened, while the saliva or liquid, etc. cannot be swallowed on account of the muscles of deglutition being involved. A pain in the stomach now comes on, as if an attack of colic were about to begin, and the diaphragm is soon affected, the patient suffering from difficulty of breathing and a spasmodic pain along the insertion of the diaphragm. The abdomen next becomes hard and knotted, presenting the appearance of a tumor, from contraction of the recti muscles, while from spasm of the muscular coat of the bowels and bladder constipation and difficulty of micturition ensue. Meanwhile the intellect of the sufferer continues clear, and the pulse natural, or by no means so much excited as might be expected from the symptoms. If the paroxysms continue they become more violent, and the patient dies in a period varying from two to fourteen days, the shorter period being rarely seen.

**Varieties.**—Tetanus receives certain designations according to the muscles which are chiefly involved in the spasm; thus, when those of mastication are principally affected it is called **Trismus,** or lock-jaw; when the patient is bent backward into the shape of an arch by the contraction of the spinal muscles and the flexors of the legs, it is called **Opisthotonos;** when he is bent forward, **Emprosthotonos;** when sideways, **Pleurosthotonos.**

**Etiology.**—Tetanus shows itself under various circumstances, and often after very slight wounds, when conditions favoring its development exist,

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atmospheric changes, and other causes which are not well known, seeming to act as predisposing agents.

The wounds most likely to produce tetanus are wounds of nerves, tendons, fasciæ, and comparatively superficial parts; lacerated and punctured wounds are more apt to create it than the other classes. In one instance in my experience it was excited by the slight puncture made by taking a top with a very sharp spike into the hand while it was spinning; and in another, a waiter at a hotel had tetanus induced by pricking his finger with a fork while arranging the table.

Tetanus is sometimes developed in wounds which would otherwise not have created it — simply by a change of temperature, as where the patient is exposed to a draught of air. Thus Baudens reports 15 cases of tetanus out of 40 slightly wounded men exposed to a northeast wind, one night, in Africa. As its earlier symptoms are those of pain and stiffness about the muscles of the neck and throat, they are liable to be mistaken for the merely rheumatic effects of a cold, or stiff neck. From the experience of the late Dr. Kane, in the Arctic regions, intense cold alone may produce it—two of his men having died after exposure, from anomalous spasmodic affections allied to tetanus, while his dogs suffered in a similar manner. An instance of tetanus in the horse, also, is within my knowledge, caused by exposing the animal, while heated, to a fresh sea-breeze, in the island of St. Croix. In India and similar climates heat is, however, regarded as a powerful predisposing and exciting cause, both probably acting by creating a centric nervous irritation as the result of a modified secretory action on the surface of the body.

Tetanus is liable to supervene on a great variety of injuries. In India, Macleod* reports 19 cases: "In 3 it followed amputation; in 3, on balls lodged in bones; in 4, flesh wounds; 1, penetrating of chest; 1, a contusion of the face; 1, a wound of the hand; 1, a needle broken in the heel; 1, on the exposure of a suppurating wound to cold air; 1, an injury to the foot; in 1, on a compound fracture; and in 1, an injury to the ankle." A variety sufficient to show that its visits are limited to no special class of injuries.

**Diagnosis.**—Hydrophobia might be confounded with this complaint, which it resembles in the difficulty of swallowing, and the increase in the violence of the spasm from very slight causes, such as the opening of the door, a breath of air, etc. It may be remarked, however, that the spasm in tetanus is continuous, (tonic;) in hydrophobia it is intermittent, (clonic;) in tetanus the mind is clear; but in hydrophobia, a delirium, which is of a maniacal character, is present, at least in its later stages. The diagnosis from myelitis, or inflammation of the spinal marrow and its membranes, is to be found first in the fact that in myelitis the patient complains of a constant burning pain in the back, and has high fever and often paraplegia, neither of which is found in tetanus except in cases complicated with myelitis.

**Prognosis.**—The prognosis of tetanus is very unfavorable, and although I do not indorse the French aphorism, "tants des cas tants des morts," (so many cases so many deaths,) yet it is very rare for a patient to recover from tetanus when it is once thoroughly developed.

The recent experience of the Crimean surgeons has not materially affected the prognosis of tetanus as formerly given—the proportion of deaths being so large as to render a cure of acute tetanus almost a miracle.

**Pathology.**—The pathological condition of the organs of the body in tetanus is doubtless a disordered state of the spinal cord, brain, and gan-

* Surgery of Crimean War, p. 154.

glionic system, but only involving the lower portion of the brain, and this chiefly toward the close of the disease. This disordered condition of the brain is not inflammatory in its character, nor is it very well understood, but may be described as being in the great majority of instances rather functional than organic, though sometimes vascular congestion is marked.

The most minute examination, even with the microscope, having failed to detect any organic change sufficient to account for the symptoms of tetanus, its true pathology is yet a vexed question. There are, however, many pathologists who explain the progress of traumatic tetanus by supposing that the original irritation of the nerves of the affected part is transmitted to the great nervous centres, where it develops a disordered functional action which first shows itself by such an excitation of the motor nerves as produces continuous spasm of the muscles of the face, the neck, trunk, and extremities, which continues until their excitability is destroyed and death closes the scene, either as the result of pure exhaustion from want of nourishment, or from apnœa consequent on spasm of the muscles of the glottis, or even of the diaphragm and heart.

**Treatment.**—The treatment of tetanus may be divided into (1) the prophylactic, and (2) the palliative measures, recent experience not having, in any material result, modified the old plan of proceeding.

1. The **prophylactic** treatment consists in such means as will avoid or remove the source of irritation. When tetanus is feared, nerves merely pricked should be entirely divided, ill-conditioned sores be freely cauterized, etc. But, when the disease is once developed, it is worse than useless to amputate the affected limb, as this operation does not check the disease, and has in some cases proved to be an additional source of irritation.

2. The **palliative** treatment is as follows : A purge should be given, if it can be swallowed, to clear out the primæ viæ ; but this is frequently impossible, on account of the trismus and spasm of the pharyngeal muscles, the latter being one reason why patients die, as it is difficult to administer remedies or food to them in sufficient quantities to obtain their prompt action. The difficulty of nourishing them is also increased by the fact that the muscular coat of the alimentary canal does not propel the food through it, owing to the continuous spasm which characterizes the disorder.

Opium may follow purges when it can be readily administered, but it should be remembered that though immense doses of this drug will be borne without producing sedation, we should not be induced by this fact to give it in such quantities as to risk a complication of the disease by producing congestion of the brain. Anæsthesia has also been recommended, and is, doubtless, useful as a means of rendering death easy, but it has as yet produced no curative results. Perhaps the most useful, as it is certainly the most plausible plan of treatment, is counter-irritation to the spine, as recommended by the late Dr. Hartshorne, of Philadelphia. His plan of treatment, which resulted in a few cures, consisted in making a free issue on the spine, near the origin of the nerves first involved, with caustic potash, and keeping up a continuous and free discharge.

The constant application of anodynes to the spine, with the administration of anodynes by inhalation, or the use of hyoscyamus, stramonium, opium, etc., smoked by the patient in medicated cigars, so as to keep up constant unconsciousness, is, I am satisfied, at least a source of comfort to the patient, and apparently tends to a cure, though it is very often unsuccessful. Chassaignac has also recently reported to the Academy of Medicine at Paris an alleged cure by the *woorara* poison, administered by the mouth, and also applied locally ; but his case was not deemed satisfactory, being of the chronic or intermittent form, which is sometimes spontaneously cured.

**Hypodermic Injections.**—Among the recent suggestions for the relief of tetanus is that of Pescheux, of France, to produce the poisonous effects of atropia by injecting ten or twelve drops of a solution of the sulphate of atropia into the areolar tissue of the front of the neck near its median line. In the case reported in the *Gazette Hebdomadaire*, the symptoms of atropia poisoning soon became well marked. When these subsided, the tetanic symptoms had almost disappeared, deglutition becoming easy and the muscular rigidity much lessened. A second injection in the evening dissipated what remained of the tetanic symptoms. In a disorder so fatal and rebellious as tetanus this plan is deserving of trial.

**Sulphate of Quinine in Tetanus.**—L. A. Dugas, of Georgia, reports a case of tetanus, due to the patient, a negro girl ten years old, having stuck a nail in her heel, successfully treated with morphia combined with large doses of quinine. The patient having been treated for twenty-four hours with morphia alone, without any amelioration of the symptoms, sulphate of quinine was administered, in doses of ten grains, combined with one-fourth of a grain of sulphate of morphia in solution, every three, four, or five hours, according to its effect.

In the course of forty-eight hours the spasms ceased, and the medicine was then gradually diminished; "the rigidity, however, persisted, and wore away gradually in the course of a week."*

**Ice.**—B. D. Carpenter, of Long Island, New York, reports two cases of traumatic tetanus successfully treated by the application of *ice* to "the head and the whole length of the spinal column.

"The ice was applied from ten to thirty minutes each time, with intervals of from two to eight hours, followed by immediate relief, the spasms disappearing in twenty minutes from application. The first patient was sixteen years old, and the cause of the affection was a wound in the ball of the right foot, made by jumping from a fence on the stump of a twig. The second patient was twenty-one years old, and suffered in consequence of a wound made in the foot by a rusty nail."†

F. Hinkle, of Lancaster County, Pennsylvania, reports a case of tetanus in a woman thirty-eight years old, caused by the bite of the severed head of an eel she was dressing, which was treated successfully by the application of chloroform along the spine and to the epigastrium.

Half an ounce of chloroform mixed with one drachm of ether was dashed suddenly along the spine and covered with a large pad of cotton; a smaller quantity of the same mixture being then applied to the epigastrium and also covered with cotton. These applications being renewed every hour, or every two or three hours, according to the urgency of the symptoms, the spasms were always much relieved by the local application, for a period of two weeks, with ultimate recovery. Mercurial laxatives, ext. cannab. ind., Hoffman's anodyne, and tinct. valerian, were also administered.‡

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* Southern Med. and Surg. Journal, 1850, vol. vi. N. S., p. 340.
† Southern Journal of Med., vol. x. N. S., p. 172.
‡ Amer. Journal Med. Sci., 1856, vol. xxxii. N. S., p. 359.

# CHAPTER IX.

THE anatomical division of the body into different regions having enabled anatomists to study methodically the various component parts of each portion, surgical writers have long pursued a similar course, and, under the general head of regional wounds, systematized such peculiarities in all wounds as were the result of the peculiar structures and organs involved in the injury. The title of **Wounds of Regions** may therefore be made to properly include lacerated, incised, contused, punctured, and gunshot wounds of the part affected, the peculiarities of all being alluded to rather in connection with the result of the injury upon special organs, than with the issue in special tissues. The prognosis of regional wounds is usually mainly affected by the importance of the adjacent organs to the life of the patient, the result being often complicated with the ordinary consequences of inflammation, as developed in each organ by other affections. The variety of the wound, its extent, the age and general habits of the patient, etc., all, however, modify the prognosis of regional wounds as they do those of a more general character. In the treatment of wounds of regions there is often occasion for the exhibition by the surgeon of all the extended accomplishments of the practitioner of medicine; if the head is wounded, the symptoms and treatment of meningitis may form a special subject for his attention; while pneumonia and pleurisy, as resulting from wounds of the chest, will require a good knowledge of auscultation and percussion. The student of surgery must therefore early recognize the importance of an accurate investigation of all the disordered and physiological actions of the human system, if he desires to treat scientifically and successfully any of these conditions, which, for the advantages of methodical investigation, and from the peculiar causes creating them, are generally assigned to the practice of surgery.

In the consideration of regional wounds we shall present them in the natural order of the anatomical division of the body, commencing at the head and passing thence to the trunk and extremities.

## SECTION I.

### WOUNDS OF THE HEAD.

**Wounds of the Head** may be of any of the varieties previously described; that is, incised, lacerated, punctured, or gunshot. But, most frequently, the wounds of this region are either incised, punctured, or lacerated; poisoned wounds of the head being seldom seen, though possible. In order to understand correctly the effects produced by wounds in this region, the general structure of the component parts of the head should be borne in mind, as

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the character of the scalp and the numerous branches of the temporal and occipital arteries ramifying beneath it; the thickness of the cranium, and the character of its two tables, with the intermediate diploë. The ramifications of the middle artery of the dura mater, just within the bone, and the size and position of the sinuses of the brain, as well as the characters of its membranes, with the proneness of the latter to take on inflammatory action, should also be noted.

**Complications.**—The chief complication in wounds affecting the scalp is erysipelas, and the sloughing consequent upon it; of those affecting the cranium, meningitis or inflammation of the membranes of the brain, and cerebritis, or inflammation of the substance of the brain itself; besides which there may be in either case the dangers arising from compression and concussion of the brain.

### § 1.—Wounds of the Scalp.

Any wound involving the external coverings of the cranium is usually designated as a wound of the scalp, whether involving the pericranium or not. In all wounds of the scalp, the presence of the hair without and the cranium within, creates some few points of difference between the varieties of wounds of this region and those seen elsewhere.

1. **Incised wounds of the scalp,** if made perpendicularly to the surface of the cranium, present usually the peculiarities of incised wounds of the integuments elsewhere. There is, however, more difficulty in ligating a superficial artery in the scalp than in the integuments elsewhere, owing to the dense character of the connective tissues in which it lies; hence a needle and ligature often answers better than the tenaculum for ligating such arteries. An incised wound of the scalp, if made in the transverse direction of the fibres of the occipito-frontalis muscle, is also more apt to gap than an incised wound of the skin over other muscles, and there is, probably, a greater tendency to erysipelas in all wounds of the scalp than in other parts, owing doubtless to the density of the areolar tissue that unites the layers that compose it, this inducing vascular congestion of the scalp by preventing the free exudation seen when inflammation occurs in other portions of the tegumentary covering. When incised wounds of the scalp are created by an oblique blow, there is also a marked tendency to the formation of a flap, the integuments being sometimes shaved off, in consequence of the convexity of the cranium and their loose attachment to the pericranium.

2. **Punctured wounds of the scalp,** if not involving a nervous filament or a deep-seated artery, are at first apparently more simple and superficial than the same class of wounds in other regions. They are, however, exceedingly liable to be followed by deep suppuration, and by erysipelatous inflammation, even when made perpendicularly to the bone, and merely through the integuments. But when a punctured wound is so inflicted as to cause the instrument creating it to glance and slip between the scalp and the cranium, the dangers of suppuration and erysipelas will be much augmented.

3. **Contused wounds of the scalp** are usually serious in proportion to their depth, being much more grave in their character when the contusion leads to an effusion of blood beneath the occipito-frontalis tendon or beneath the pericranium. When the contusing agent ruptures blood-vessels without materially wounding the integuments on the surface, the hemorrhage may continue slowly till it thoroughly infiltrates the portion injured and creates a well-marked circumscribed tumor. As these swellings are often soft in the centre and harder toward the circumference, they are liable to be mistaken

for depressed fractures of the cranium—an error which may, with care, be guarded against by carefully shaving the scalp and pressing with the fingers of each hand, from the circumference of the swelling to its centre, or by striving to render fluctuation distinct.    Contused wounds of the scalp are very liable to be followed by the liquid products of inflammation, and to demand an early evacuation of their contents should erysipelas of the scalp or constitutional fever supervene.    If a nervous filament has been injured, they are also often followed by neuralgia of the scalp.

4. **Lacerated wounds of the scalp** are frequently of an extended character, the scalp being so movable upon the pericranium as to be readily removed from its attachments when even moderate force is applied to it.    In the case of a glancing blow with a dull or blunt instrument, in the injuries inflicted by the wheels of vehicles, by machinery, and even by round shot, the scalp may be lacerated and removed from its connection with the pericranium to a greater or less extent, while, as the force generally throws the patient down, dirt and other foreign matter is incorporated with the displaced flap. Lacerated wounds, as already stated, bleed but little in any region.    In the scalp this is especially true, as the trunk of the blood-vessels remains in the displaced flap, their ends being torn in the edge of the wound in such a manner as to induce the contraction of the orifice.    Owing to this peculiar position of the blood-vessels, the vitality of even an extensive flap in a lacerated wound of the scalp will be preserved when separated from the skull on one side for days, the other being continuous with the integuments of the head.

5. **Gunshot wounds of the head** necessarily involve the scalp, but the importance of the injury of the bone causes that of the scalp to appear unimportant.    When a ball wounds the scalp it may cut it like a knife and graze the bone, or penetrate the scalp, and not the bone, traveling beneath the scalp in a course indicated by a whelt or puffy track, and require to be removed by an incision ; or the ball may escape from the scalp and leave a lacerated wound.    In all scalp wounds, and especially in gunshot, too much attention cannot be given to prevent the burrowing of pus.    When erysipelas appears in the track of a ball, incisions into the puffy tissue, parallel to the course of the occipito-frontalis, are essential to its relief; after which tepid mucilage-cloths or the tepid or cool water-dressing will prove highly advantageous.

**Diagnosis.**—The diagnosis of wounds of the scalp is usually easy after the hair is shaved off ; but contusions, with liquid effusions beneath the pericranium and scalp, are liable to be mistaken for depressed fractures of the skull, from which they may be diagnosed by a careful examination by the touch.

**Prognosis.**—As a class, all extended wounds of the scalp are serious. 1. From the liability of the cranium and brain to be injured by the cause wounding the scalp.    2. From the frequency of erysipelatous affections. 3. From the disposition to the formation of abscesses beneath the occipito-frontalis tendon or the pericranium, some days after the edges of the external wound have healed.

**Treatment.**—Without recapitulating such general points as have been already alluded to in connection with the treatment of incised, lacerated, and other varieties of wounds elsewhere, it may suffice at present simply to refer to such as are specially connected with this portion.    In all wounds of the scalp, it is generally best to shave the hair for a short distance from the margin of the wound in order to enable the surgeon to correctly adjust it, preserve cleanliness, prevent the irritation of foreign substances in the wound, and enable us to see the extent of any subsequent inflammatory action that

may arise. Having done this, the wound should be thoroughly cleansed by squeezing water gently upon it, and any main arterial branch that may be bleeding either stimulated to contraction by torsion with the forceps, closed by the application of a ligature, or, if the hemorrhage is less, gently compressed by the subsequent application of a recurrent bandage of the head. This bandage, Fig. 63, or a night-cap or a handkerchief, Fig. 95, furnishes the best means of retaining dressings to the head. If an incised wound is so situated as to gap, it may be necessary to approximate its edge by adhesive strips; but if the wound does not gap, and is not over an inch in length, it may be sufficiently approximated by a couple of compresses lightly applied near its edges, and gently retained there by the well-applied turns of the recurrent bandage of the head. In closing extensive incised wounds of the scalp, it will generally be found best not to unite them accurately throughout their entire length, but to leave some depending point a little open, as a vent for any subsequent suppuration that may follow the injury of the deeper portions. The danger of transfixing the occipito-frontalis tendon, and the irritation caused by the presence of a foreign body—as a thread—with the increased tendency to erysipelas, have long induced surgeons to object to the use of sutures in wounds of the scalp. Since the use of metallic sutures has become so common, many surgeons have, however, again employed them almost exclusively in wounds of the scalp, but their application is rarely of advantage, even if productive of no harm. The wound seldom gaps at all, and can often be retained in place, without resorting to painful measures, by the simplest means, such as parting the hair in the direction of the wound, then crossing the hairs to the opposite sides and retaining them in position, even without tying them, by means of a compress and bandage. But in flap wounds it is better to shave the scalp on either side of the wound for a short distance, and employ collodion and Donna Maria gauze, this being preferable to adhesive plaster, as it adheres better, and necessitates the removal of less hair. After properly approximating the edges of an incised wound of the scalp, a piece of lint wet with cold or tepid water, or water properly tempered to the heat of the part, constitutes the best dressing. At the same time attention should be given to the condition of the digestive organs, and purgatives employed if requisite.

The treatment of punctured wounds depends mainly on their extent, direction, and the character of the instrument that creates them. When slight, little more is necessary than to shave the hair around the wound, and apply lint, with fresh water, retaining it in place by a T-bandage of the head, or some other light covering. But the liability of even apparently simple punctured wounds of the scalp to be followed by subsequent suppuration and by erysipelas should induce caution in the prognosis and careful attention for several days. When a punctured wound of the scalp opens the branches of the temporal or occipital arteries, it may become necessary to cut down and tie the main trunk, if the ligation cannot be made at the wound, or the bleeding checked by a well-applied bandage. Such an incision increases, however, the difficulties of the case, is not often necessary, and should not be resorted to until the other means have failed. Owing to the depth at which the occipital artery is placed, the operation of ligating it is by no means an easy one, and yet such a course is especially requisite in wounds that involve this vessel. In all cases of wound of the occipital artery, the attempt should be made to ligate it in the wound. A judiciously regulated diet, moderate purging, rest, and careful attention to prevent the burrowing of pus after oblique punctured wounds of the scalp, usually will be required.

The treatment of lacerated scalp wounds is very much the same in

principle as that of lacerated wounds elsewhere. As these wounds do not usually heal readily, it is useless to attempt immediate union by an accurate adjustment of their edges. When the granulations of lacerated wounds tend to become exuberant or flabby, gentle stimulation, with the nitrate of silver or lint wet with a weak solution of sulphate of copper, will often prove useful.

Should erysipelas supervene during the healing of lacerated or other scalp wounds, it will tend to invade the entire scalp, and often augment the subcutaneous suppuration. Under these circumstances, the tepid water-dressing, or lint wet with warm mucilage, will prove a grateful application; or, in feeble patients, the local application of the tinctura saponis camphorata of the United States Pharmacopœia, will excite a more healthy action. But in erysipelas of the scalp, as in traumatic erysipelas generally, the local irritation is only evidence of constitutional derangement. Though very familiar with the application of the nitrate of silver, tincture of iodine, prot. sulph. of iron, etc., as circumscribing agents in an attack of erysipelas, I have but little faith in their efficacy. When they appear to check the local progress of erysipelas in some cases, it is probably only a coincidence, as in other instances the disorder will readily pass beyond the line of new inflammation created by the nitrate of silver that was intended to arrest its progress. The judicious employment of purgatives, with the subsequent administration of the tinct. ferri chlorid. and quinine, with good diet, affords certainly the best means of arresting erysipelas when developed in connection with wounds of the scalp; but in erysipelas of the scalp, as in erysipelatous inflammation of other parts, the local disorder must be regarded as evidence of a constitutional disturbance, and the treatment regulated on the principles heretofore detailed.[*] Guthrie advises[†] that the moment the surface of a wound of the scalp becomes pulpy, and changes from a red to a yellowish color with a thin discharge instead of good pus, an incision should be made through it and repeated, if necessary, as this relieves the tension and the irritative fever, and prevents the delirium which would follow. By not closing the wound at first, this operation may be avoided.

### ₰ 2. —Wounds of the Skull.

**Wounds of the skull** may be superficial or penetrating, their results depending greatly on their extent and depth. In studying the general points of importance in connection with these injuries, we must limit our remarks to such as are most generally met with.[‡]

In all these injuries the peculiar conformation and structure of the cranium, and the varied character of the forces applied to it, together with the peculiar and unknown action of the brain under varied circumstances, combine to render them among the most complex and important injuries that are presented to the surgeon. They may therefore be advantageously studied under two heads—first, as injuries of the cranium; and second, as injuries of the brain.

**1. Injuries of the Cranium.**—The convexity of the outer surface of the cranium, the intervention of the diploë between the outer and inner tables, the position of the pericranium and the dura mater, of the sinuses of the membranes of the brain, of the arteries of the dura mater, as well as the position

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* See page 284.                          † Commentaries. Phila. edit., p. 363.
‡ Those desirous of a more detailed account are referred to the work on "Injuries of the Head affecting the Brain," by Mr. Guthrie.

of the frontal sinuses, and of the mastoid cells, all tend to modify the result noted in connection with the injuries inflicted on different portions of the cranium. The result also differs greatly, according to the character of the force producing the injury, sabre cuts, axes, circular saws, clubs, etc. creating one class of injuries, while gunshot wounds form another, the fractures resulting from balls not corresponding in all respects with those induced by the first-mentioned causes. Hence the opinion of Guthrie, "that injuries of the head affecting the brain are difficult of distinction, doubtful in their character, treacherous in their course, and for the most part fatal in their results," is generally received as exceedingly correct, especially in reference to the more marked cases. The statistics of the injuries of the head furnished by various writers sufficiently attests this. Thus Alcock reports 28 cases of gunshot fracture of the skull and 22 deaths; while Lente, of the New York City Hospital, reports 128 cases of fracture, none of which were the result of gunshot wounds, with 106 deaths. As the subject of fractures of the skull created by ordinary forces is hereafter treated of in connection with the fractures of other bones, the present account will be confined to the subject of gunshot injuries of the cranium.

The character of the injury inflicted by a ball striking the skull depends greatly on the size and character of the missile, its velocity, and the angle at which it strikes the head. When large balls merely graze the head, or simply brush over it, the injury is often most serious, the sinuses and arteries of the dura mater being ruptured, and even the internal table fractured and depressed, while the outer table, or even the scalp, may be but slightly involved. Various instances illustrative of the diversified character of these injuries are to be found in most of the works on military surgery. Thus Macleod relates* "that a round shot 'en ricochet,' or bounding from the ground, struck the scale from an officer's shoulder and merely grazed his head as it ascended. Death was instantaneous; the scalp was found almost uninjured, but the skull was so completely fractured that its fragments rattled in the scalp as if loose in a bag."

When a bullet strikes the cranium very obliquely it often glances so as to create only a contused or apparently incised wound of the scalp or pericranium; or it may fracture the external table and bury itself in the diploë; or if it impinge on an angle of the skull, as the orbital process, it may be split, and the fragments travel in different directions; or it may be flattened and not fracture the bones. When a ball strikes the temple or the inferior anterior angle of the parietal bone, it may rupture the middle artery of the dura mater and give rise subsequently to the symptoms of compression of the brain, or it may bury itself beneath the fascia of the temporal muscle.

When a bullet, and especially a conical or Minié ball, strikes more perpendicularly, or when its velocity is sufficiently great, it will directly enter the cavity of the cranium and bury itself in the brain, or it may again escape on the opposite side of the head. Sometimes a bullet that has been split on a bone has penetrated the skull and brain with one fragment, while the other, traversing the exterior of the cranium, has escaped through the scalp at the opposite side, thus creating the impression of a ball having entered and escaped from the head.

When a bullet enters the head it sometimes splinters the inner table more than the outer, in consequence of the greater density of the former, and on the principles which interpret the difference between the wound of entrance and exit in the soft parts.† In young persons, and especially in children in

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* Op. citat., p. 162, Phila. edit.
† Macleod, p. 163, Phila. edit.

whom ossification is not completed, this is not so. The character of frac-
tures of the skull caused by the Minié bullet is thought by Macleod* to be
very different from that caused by the round ball. The destruction of the
outer table has always appeared to him to be much greater than by the round
ball, the size of the openings in the two tables being more equal in the conical
than in the round bullet wounds.

Shell wounds of the head are very apt to prove fatal from the serious
injury caused to the brain by the fragments of bone driven into it.

Sword cuts of the skull, especially those made by a dull edge, are generally
dangerous, from the splintering and depression of the inner table. In the
feuds of the fire companies in some of our large towns similar wounds are
often brought to the notice of hospital surgeons as inflicted by axes, span-
ners, fire-horns, etc.

For many years surgeons entertained the opinion that wounds of the head,
particularly those inducing injury of the cranium, were very liable to be fol-
lowed by an abscess in the liver, and some of the cases cited appeared to support
this opinion, which was specially maintained by the Italian surgeons, as pub-
lished in the Memoirs of the Parisian Academy of Surgery. Without dis-
cussing the explanations offered as to such a complication, I think we may
safely unite in the opinion of Guthrie, who states "that unless the liver
is really injured by a blow or fall, it only becomes affected in a secondary
manner, like the metastatic abscesses of the lungs, etc., as a consequence of
secondary amputation." Macleod also states† that he seldom saw hepatic
abscess follow an injury of the head, though jaundice was present in several
fatal cases of injury to the head.

The injury resulting from wounds of the cranium is, however, so varied as
to render it difficult to prognosticate the result, some which are apparently
most unfavorable recovering, and the reverse.

Fardeau‡ relates a case of a bayonet that was driven into the right
temple, two inches beyond the angle of the orbit and a little above it, that
passed up to the hilt from before backward, and from above downward, so
as to traverse the maxillary sinus on the opposite side and project five inches.
The bayonet was dragged out by putting one foot against the patient's head
as he lay down, and pulling it with both hands. Its extraction was followed
by a very free hemorrhage, yet the man recovered, though with the loss of
sight on the right side.

Paul Eve, of Nashville, in addition to many other examples of serious
injury of the head, refers§ to the case reported by Harlow, of Vermont, in
which a "tamping iron," used in blasting rock, that weighed $13\frac{1}{4}$ pounds, and
was 3 feet 7 inches long and $1\frac{1}{4}$ inches in diameter, was driven, by a prema-
ture explosion, through the cranium, in a straight line from the angle of the
jaw on one side to the centre of the frontal bone above, near the sagittal
suture, where it emerged, and was picked up some rods distant, smeared
with brains and blood. This man recovered, and has since been seen by
many.

Fractures of the skull will be again alluded to under the head of Fractures.
At present it must suffice to state that even when an injury of the skull is so
violent as to create a fracture, the injury is serious mainly in proportion to
its effects on the brain. In connection with this comes the question, "Does
a blow on the head ever cause *immediate* death?" an answer to which is
found in the statement of Lente, of West Point,|| "that in no case (out

* Op. citat., p. 164, Phila. edit.                              † Op. citat., p. 197.
‡ Journal de Chirurgie, as quoted by Chelius, p. 471, vol. i.
§ Surgical Cases, p. 66.                                        || New York Journ. Med.

of 117 reported) did death follow the receipt of the injury for some hours."
Hamilton, in his fracture tables, reports 12 deaths out of 33 cases, as cor-
roborative of the same. The after-treatment of gunshot wounds of the
head requires long and careful supervision, "relapses occurring long after
the patient is apparently beyond danger, and from the most insignificant
causes."*

2. Injuries of the Brain.—Sometimes blows and other forces applied
directly or indirectly to the head, and altogether independent of the produc-
tion of any external injury, induce an effect on the brain that is designated
as "Concussion of the brain," or, as it is ordinarily called, stunning. They
may also create Compression of the brain, by causing a depressed fracture
of the skull, or the rupture of blood-vessels and effusion of blood within the
cavity of the cranium.

1. Concussion of the Brain is a marked interruption of its function, some-
times unaccompanied by any visible injury, and may be caused by any force
that shakes or jars violently this structure. It may be produced by falls,
either upon the head or upon the feet, as well as by blows.

Concussion of the brain produces a train of symptoms which are illus-
trative of the nervous connections between the brain and other parts of the
body, all feeling the cerebral injury. Thus the nervous connection that ex-
ists between the brain and the stomach is so great that it has been jocosely
said that a man has two brains, one in his abdomen (the solar plexus) and
the other in his head, in consequence of which an injury to the head is very
apt to cause vomiting, while a violent blow upon the stomach will often
destroy consciousness, or produce death, by impairing the action of the brain.

Symptoms.—The symptoms of concussion of the brain have been arranged
by Abernethy into three stages.

In the first stage the condition is that of collapse, and this is the state in
which the surgeon, if he has been promptly called, will generally find the
patient. The second stage presents the symptoms of reaction, and the third
those of inflammation.

In the first stage, or that of collapse, the patient will be found lying mo-
tionless, unconscious, insensible, and unable to answer questions; the skin
cold, and the pulse feeble, while the pupil will usually be contracted or irregu-
larly dilated. If the injury is not a very severe one, the patient may be
roused by shaking him and shouting in his ears, so as to enable him to an-
swer questions imperfectly, after which he is apt to relapse into his uncon-
scious condition. This state may continue for a varied period of time, as
from half an hour to four or five hours, after which evidences of reaction
usually appear. In the second stage the pulse becomes fuller, and the skin
warmer; there is a slight return of color to the lips; and the patient becomes
restless and pitches about like a person in a troubled dream, muttering, and,
perhaps, speaking in a language which he had long forgotten, or which his
friends had not supposed him to know. Whatever he may say is, however,
generally very incoherent and disconnected in its character.

After this he may begin to vomit, and after vomiting is often much relieved,
and from this period usually begins to improve, his consciousness gradually
returning, though he continues for some time feeble, and recovers perfect
consciousness very gradually. In more severe injuries, however, he remains
unconscious, the surface continues cold, the features pallid, the pulse quick,
particularly when he is aroused, it sometimes rising under a little excitement
from 90 to 130 or 140 beats per minute, or beats so fast that it is impossible
to count it. Sometimes, however, the pulse is more full and regular. The

* Macleod, op. citat.

respiration is also varied, being sometimes very feeble or followed by a deep sigh, and then interrupted by an almost total absence of breathing for a few seconds, so that one is tempted to apply a glass to the lips to see if it is actually going on, auscultation hardly giving a sound. This state of things may last for some time, the patient being still able to swallow although unconscious, until finally the case terminates in recovery or in the third or inflammatory stage, which may end in death.

In concussion many mental phenomena—which well deserve the name of eccentric—will be observed at times; thus patients will begin to answer a question and not complete the sentence, or they will begin a sentence in one language and complete it in another, etc. They will also often be entirely unconscious of all events from the time of the injury until they recover their full senses, embracing sometimes many days. Occasionally they are for a long time subsequently unable to endure the heat of the sun, or to undergo any mental excitement without suffering.

**Diagnosis.**—The diagnosis of concussion of the brain is highly important, and will be treated of fully under the head of Compression, this being the condition with which it is most liable to be confounded.

**Pathology.**—A post-mortem examination in concussion of the brain shows various morbid appearances; thus there may be congestion of a part or of the whole brain, or an effusion of blood, but the latter is seldom to any extent if the symptoms have not been complicated with those of compression. Most frequently there is no structural change whatever to account for the symptoms, thus indicating that the disorder of the brain in this injury is merely functional.

**Prognosis.**—The prognosis of concussion should always be guarded. The condition is not only dangerous in itself, but also serious from the congestion and inflammation of the brain which may supervene.

**Treatment.**—The treatment of concussion will depend upon the stage at which the patient is first seen. If seen in the state of collapse, the attempt must be made to excite action in the surface by frictions, sinapisms, and stimulating injections into the rectum, such as salt and water, the turpentine injection, etc.

Under no circumstances should the surgeon yield to the popular desire, or the wishes of friends, and extract blood, in the first stage of concussion of the brain. When blood is abstracted at this stage, the collapse will be increased, and if faintness is induced, death will rapidly follow. In the third stage, when reaction ensues with febrile action, and a tendency to strong congestion, blood may be taken to such an extent as would be proper under the same condition proceeding from any other cause, on the principles before alluded to at page 237.

Sometimes, after reaction is fully established and inflammation begins to be developed, the symptoms of meningitis appear. Thus mania may present itself, during which the patient will shriek out or scream violently, this being regarded as one of the fatal symptoms in cases of concussion. But although meningitis in these cases frequently proves fatal, the patient may yet recover under the ordinary treatment of meningitis proceeding from any other cause; as by the use of purgatives and emetics, with, subsequently, the employment of counter-irritants. Opiates should seldom be administered in cases of concussion, no matter how restless the patient may be, except in moderate doses, as they are apt to add to the congestion which may already exist in the brain, and thus eventually aid in developing inflammation.

2. **Compression of the Brain.**—Instead of the simple disturbance of the functions of the brain just described, an interruption of its action by some mechanical cause acting directly upon it and producing compression of its

structure, is often met with. This cause may be a force applied to the walls of the cranium so as to drive them in, or an effusion of blood upon the membranes of the brain, that is, between them and the cranium, or in the substance and cavities of the brain itself, or between the brain and its membranes.

**Symptoms.**—When compression of the brain is marked, complete insensibility may result, precisely as in apoplexy, and we therefore usually find a slow, full pulse, with unconsciousness; a dilated pupil, with stertorous or snoring respiration, the latter being due to the paralysis of the muscles of the soft palate, which, permitting it to droop, cause the air to enter and escape by the nostrils. Respiration is also exceedingly slow, being often not more than five or six times in a minute, the breath escaping with a peculiar whiff or puff from the corners of the mouth, in consequence of the imperfect action of the buccal muscles. If the patient recovers a little from this condition, headache and torpor of the intellectual faculties will be observed, or symptoms similar to those detailed under concussion, though generally he either recovers entire consciousness or dies with the evidences of apoplexy, or inflammation of the brain or its membranes.

**Diagnosis.**—Compression of the brain, whether due to an effusion of blood within the cranium or to a depressed fracture, may be told from concussion by the fact that in concussion there is feeble respiration, in compression it is stertorous; in concussion the pupil is usually dilated, in compression contracted, though as it varies in both but little can be positively learned from its condition; in concussion we have a quick, feeble pulse, counting 90 to 130; in compression it is slow, labored, and full, counting often only 30 or 40 in a minute; in concussion the patient may be partially roused, but in marked compression he is, and remains, totally insensible.

Compression of the brain may be told from drunkenness by a close examination of the circumstances of the case, though it will be much aided by discovering the odor of liquor upon the patient's breath. Still, the two affections may exist together, and the presence of compression or concussion in a case of drunkenness can often be positively ascertained only by time.

**Prognosis.**—The prognosis in compression of the brain depends upon the amount and character of the injury. If it is due to a clot of blood, and the stupor increases, while the other symptoms grow more and more marked, the danger of death is imminent; but if the symptoms remain stationary, or materially improve, there will be greater probability of the patient's recovery. If the compression is due to a depressed fracture, and this can be raised, the prospect of recovery is usually fair, unless meningitis supervenes.

**Treatment.**—The treatment of compression of the brain must depend upon circumstances. If the symptoms are evidently due to a depressed fracture of the cranium, recourse may be had to the operation of trephining; but on this point there is a great diversity of sentiment, modern surgeons greatly discountenancing its performance, as a general rule, especially in military practice. Stromeyer, as a student, attended for three years the hospitals in Berlin, Paris, London, and Vienna, and never saw a case recover after this operation; yet he has seen apparently desperate cases of fractures of the skull recover without an operation. Among many others he refers to eight patients with depressed fractures of the cranium and cerebral symptoms received after the battle of Kolding. Seven recovered without any operation. In the eighth he removed the splintered portions of bone on the seventh day, and he also recovered.*

Macleod says: "As to the use of the trephine—the cases and time for its application—less difference of opinion, I believe, exists among the expe-

* Stromeyer, op. citat.

rienced army surgeons than among civilians; and I think the decided tendency among them is to indorse the modern 'treatment by expectancy,' and to avoid operations, except in rare cases."*   And again he says: "If any patients were lost from not having been operated upon, I never saw any of them; but I do know of some patients who died because they were subjected to the operation."†

Guthrie remarks,‡ when alluding to depressed fractures of the inner table of the skull, that "there can be no hesitation in saying that in all such cases the trephine should be applied although no symptoms exist.   A patient very often survives a mere depression of the skull, but it has not been shown that he ever does survive and remain in tolerable health after depression, with fracture of the inner table, when portions of it have been driven into the dura mater."  The danger resulting from the application of the trephine in such cases bears no proportion to the risk incurred by leaving the bone as a constant source of irritation.

Such experience as is here cited should tend to create distrust of the practice so long resorted to in these cases.   But if there is no such fracture, and the symptoms of compression steadily increase, as after the receipt of a blow, we may fairly conclude that the compressing cause is an effusion of blood. In this case it would be useless to trephine with a view to the evacuation of the blood which has been effused, for there can never be any certainty as to its situation.   Yet if there is such a fracture of the skull that the surgeon can see through the cranium to the dura mater, and perceive beneath it a large and increasing effusion of blood, it may become a question whether this blood should be evacuated or not, and this question may be answered by laying down the rule that, if the symptoms are such as show that the immediate dangers from compression are so great as to overbalance those arising from the meningitis which the puncture may induce, the operation may be performed.   Still, even after the clot is evacuated, there is no certainty that the hemorrhage will be arrested, and we must, therefore, strike a balance between the dangers in such cases, assuming as the general rule in all cases that the result of trephining is doubtful, while numerous cases are recorded in which depressed fractures have been found in the skull on a post-mortem examination, without inconvenience having been caused by them during life. Hemorrhage from the middle artery of the dura mater may be checked by compression, or by plugging with a bit of wood the little channel made in the bone for the artery, when it is accessible through a fracture.

3. **Hernia Cerebri and Fungus of the Dura Mater.**—*Fungus cerebri* and fungus of the dura mater are two fungoid growths which differ materially in their characters, though appearing in the same region of the body, as the result of injury.   *Fungus of the dura mater* presents simply the structure and appearance of exuberant granulations, its formation being due to lymph having been effused and become organized.   As this growth progresses, it produces absorption of the inner table of the cranium, and then by pressure stimulates an increased development of the structure of the diploë and external table, so as to create the various bony structures which coalesce and constitute what was formerly known as spina ventosa.   This tumor may even go so far as to encroach upon the cavity of the orbit by causing absorption of its bony plate, and then push the eye forward, and should be regarded as connected with bony tumors of the skull.

**Hernia cerebri** or a protrusion of the brain substance is created by an

* Surg. of War in Crimea, p. 169.   Phila. ed.
† Ibid., p. 173.
‡ Commentaries, p. 328, et supra.   Phila. edit.

expanding of the brain which is protruded through some wound or opening in the skull, Fig. 199, in consequence of pressure from within, such as that made by a collection of pus in abscess of the brain, etc., and occurs sometimes after the operation of trephining.

Fig. 199.



A representation of a true Hernia Cerebri consequent on a fracture of the skull, which was trephined. (After a cast from Nature.)

**Symptoms.**—The substance expanding in this instance pushes through the orifice made by the trephine, and shows itself outside in the shape of a mushroom-like projection, grows by degrees larger and larger, till finally the neck being constricted the mass may slough off. The neck then beginning to develop itself anew, the complaint progresses until much of the brain substance is sloughed off, when the patient dies of meningitis or exhaustion.

**Pathology.**—Hernia of the brain may occur from syphilitic caries, or absorption of the cranial bones. Dr. Weir, in a valuable paper,* has collected the records of 55 cases from the medical journals and New York Hospital records—31 of his cases occurring in the New York Hospital.

In these, the size of the tumor varied from that of a hazel-nut to a mass 6 inches long, and by $3\frac{1}{2}$ inches transverse diameter, generally covered with granulations, and often, though not always, giving a profuse and sometimes fetid discharge. It is, in the majority of cases, the seat of marked pulsation, and moves also with respiration and during coughing.

The protrusion, in 28 *examined* cases, resembled the brain tissue in 22, with clear distinction of cortical and medullary substances; in 4 cases, the protruded substance constituted a "clear red mass;" in 1 case, was composed of exuberant granulations; and in 1, was "fungoid in its nature." In a number of the cases an *abscess* of the brain was found to exist beneath the hernia.

Rokitansky states that "in hernia cerebri the *brain* is protruded through accidentally-arising or intentionally-made apertures in the skull and dura mater, in a condition of inflammation or exuberant granulations. Occasionally, in consequence of incarceration by openings in the cranium and dura mater, the hernia becomes sloughy throughout its whole mass, and is thus cast off."

Rokitansky also says, in speaking of *lacerated wounds of the brain:* "They heal by granulations, which fill the chasm with a cicatricial tissue, and which, now and then, are excessive, and grow outward through the opening in the skull, forming the so-called *fungus cerebri* of surgeons."

These cases have been noticed most frequently in males; and in the 55 recorded, the age of the youngest patient was $2\frac{1}{2}$, and the oldest 46 years. In but 4 of the cases were there *no* cerebral symptoms; in all the others there was either pain, paralysis, coma, convulsions, or delirium, or some combination of these symptoms; 13 *cases recovered*, 42 *died*.

With regard to the frequency of the affection, it appears that of 128 frac-
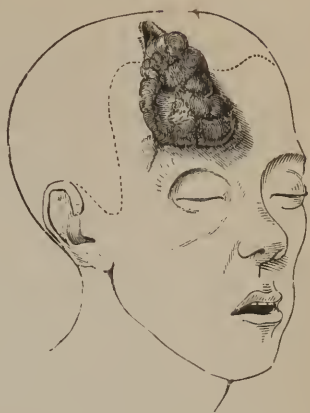
* Hernia Cerebri of Traumatic Origin, etc., by R. F. Weir, M D. N. Y. Journ. of Med., vol. vii. N. S. p. 291, 1859.

tures in the New York Hospital, from 1839 to 1851, there were 10 cases, or 8 per cent., of hernia cerebri.

Of 57 operations for fracture of skull reported in *London and Edinburgh Medical Journal* for 1844, there were 14 cases of hernia cerebri, or 1 in every 4 cases.

Of Dr. Weir's table of 31 cases occurring in the New York Hospital, from 1837 to 1858, 5 recovered and 26 died.

All of these cases were seen in connection with depressed fracture of the cranium, and in *two* of the cases the *trephine* had been used.

**Treatment.**—When, after trephining, or after wounds of the skull, there is reason to anticipate the formation of granulations, a moderate amount of pressure should be cautiously employed, in order to prevent rupture of the dura mater and the escape of the contents of the cranium. If a hernia has formed, it will sometimes be desirable to remove it by applying a ligature, and tightening it around the protruding portion with the greatest caution, from day to day, till the whole has sloughed off; after which a compress wet with lime-water may be applied to the part, as was first recommended by Sir Astley Cooper; or the tumor may be shaved off by the scalpel, and the lime-water applied to the cut surface. The tumor is very apt to return; but it is worse than useless to attempt to prevent this by the use of caustics.

The treatment of hernia cerebri, in the New York Hospital, is thus stated by Weir:* "Pressure is first resorted to, graduated according to its influence on the cerebral functions; if this does not suffice, caustics and excision are employed—the latter, especially, if the hernia be large. Frequently the sloughing produced by the strangulation of the mass is of itself adequate to its removal, and sometimes the protrusion spontaneously subsides.

"Pressure, in this Hospital, is generally applied by means of a plate of lead, the size of the cranial vacuity, placed over the aperture with several thicknesses of lint interposed, and the whole secured by a firm bandage, which serves quite effectually to control any disposition to protrusion of the tumor. With these means, the occasional use of the solid nitrate of silver is combined."

## SECTION II.

### WOUNDS OF THE FACE.

**General Remarks.**—Wounds of the face may involve any portion of this region, and although they sometimes produce great deformity, are not generally dangerous to life. Occasionally, however, they are of a serious character, as when a ball passes through the root of the nose and shatters the ethmoid bone, the injury being transmitted to the brain through the cribriform plate, or when it passes through the orbit and destroys the eyeball, a shocking example of which I saw after the battle of the 23d of March, at Winchester, under General Shields. The usual danger of wounds of the face is, however, mainly dependent on hemorrhage, which is sometimes singularly free, although there are no large vessels to be wounded, a shot through the cheek often bleeding freely, as if from enlarged capillaries; or these wounds may result in the loss or interruption of the function of the nerve wounded; hence all of these wounds should be carefully watched before being closed, and then, as a general rule, united by suture rather than by adhesive plaster, in order to insure accuracy of adjustment in a relaxed tissue. When, from loss of substance, the strain on a suture is marked, strips of ad-

* Op. citat.

hesive plaster may be required as an additional support, or a uniting bandage
like the fronto-occipito labialis of Mayor, page 149.

1. **Wounds of the Eyebrow**, when occasioned by blunt or pointed instru-
ments, are liable to be followed by severe neuralgia of the supra-orbital
nerve and its branches, and require the exsection of a portion of the trunk
near the supra-orbitar foramen, provided milder means fail to give relief.
Ptosis or paralysis of the levator palpebræ muscle, and the consequent falling
of the lid, also sometimes ensues on contused wounds of this region. Wounds
of the eyebrow are best united by means of the fine silver suture, being sub-
sequently treated by the cool water-dressing. In most wounds of the eyelids
or eyebrow, an infiltration of the loose subcutaneous areolar tissue of the
lids may be anticipated, but this will yield readily to cold and moderate
pressure, or to such minute scarification of the skin as will permit the exit
of the effused blood.

2. **Wounds of or adjacent to the Lachrymal Sac** are liable to be followed
by dacryocystitis and fistula lachrymalis, and should be treated as directed
for this condition under the affections of the eyes, in vol. ii.

3. **Wounds of the Cheek** may, in addition to the hemorrhage just alluded
to, also develop paralysis of the face from injury to the nerve and its branches,
or create salivary fistula from opening the duct of Steno.   To relieve the
paralysis resulting from the first, a blister applied to its point of exit under
the ear near the stylo-mastoid foramen, and repeated from time to time, the
raw surface being dusted with one-eighth of a grain of strychnia and a
little powdered gum-arabic; or a current of electricity may be advan-
tageously transmitted through the course of the nerve, though after union
the function of the nerve will often be restored.

Salivary fistula will generally require an operation for its relief, as will
be described in vol. ii. Wounds of the facial or temporal artery may demand
the ligation of the main trunk of these vessels as hereafter described.   Occa-
sionally severe wounds of the face, accompanied by burns, are produced by
the premature explosion of a blast of rocks.   In these cases though the skin
is often seriously injured, the eyesight remains uninjured, owing to the quick
covering of the balls by the eyelids; but at other times the eyeballs them-
selves are wounded, so that the subsequent inflammation destroys vision.
The treatment of this latter as well of wounds of this organ will be given in
connection with the diseases of the eye.   To soothe the primary suffering
from a burn of the face, the means already alluded to (page 423) will be
demanded, the water-dressing being retained by a handkerchief applied as
in Fig. 99.   The grains of powder that often remain beneath the skin and
create deformity should be treated by the application of the bichloride of
mercury, in solution, (gr. v to f$\mathfrak{Z}$j,) as before directed, page 424.

4. **Wounds of the External Nose** should be closed by the silver suture as
soon as possible, and the inflammation counteracted by the water-dressing,
retained in position either by the double ⊤-bandage of the nose, page 131,
or by the nasal sling, page 142.   In introducing the sutures in wounds of
the nose, care should be exercised not to carry them through the nasal car-
tilages.   When a portion of the external nose has been entirely removed, it
should, if possible, be replaced, and retained in position in the hope of union,
success being sometimes most marked in apparently hopeless cases.   But if
this fail, the deformity may sometimes be relieved by some of the plastic opera-
tions described in vol. ii. in connection with this organ.   When wounds of
the base of the nose involve the frontal sinus, it is not uncommon to find air
escaping from the wound as the patient respires, or to find the forehead, eye-
lids, and adjacent parts emphysematous from the infiltration of the areolar
tissue.   The perfect apposition of the external wound, covering it with a

compress and then making judicious pressure, will sometimes be necessary; but if the emphysema continues, the wound of the integuments had better be left freely open to permit the exit of the current of air from the nasal cavity.

5. Occasionally it has happened that a ball has gone through into the **Antrum Highmorianum,** and, not having been extracted, has developed an inflammation that has resulted in the formation of an abscess of the antrum. In such an event, we must treat the abscess as if it had resulted from any other cause, as by drawing out a tooth, puncturing the cavity of the antrum through the alveolar process, evacuating the pus, washing the antrum out by means of a syringe introduced through the opening in the alveolus, and afterward, if a tumor forms in the antrum, treat it by such means as may seem most judicious, and are hereafter described in vol. ii. When the lip is cut through, the sides of the wound should be united by the hare-lip suture, or if this is not at hand, by means of a handkerchief folded into a cravat, and applied as shown in Fig. 98.

Sometimes it happens that wounds are inflicted within the *mouth*, knocking out the teeth, and involving the tongue, the gum, the alveolar process, the palate, etc. Wounds of this sort are frequently made in marble yards, by the end of an iron crowbar or long lever flying up and striking the patient in the mouth. Under these circumstances, the treatment consists in moulding the teeth into a proper position, and then keeping down inflammatory action by cold and astringent applications.

6. **Wounds of the Tongue** may arise from its being bitten by the patient himself, in convulsions; or it may be wounded by balls, especially those passing into it from under the lower jaw. In these cases, if the deeper-seated portions of the organ are wounded, the hemorrhage will be troublesome, and when such is the case the ligature should be employed to arrest it, a suture being resorted to if the wound is large, for the purpose of closing it. Many surgeons object to the use of sutures in wounds of the tongue, because they quickly tear out, and resort to the hare-lip pin, which will be found secure and often sufficient of itself to control all hemorrhage; but I have seldom found trouble from their employment, if not too tightly drawn. In order to apply a ligature to the artery in a wound of the tongue, some means of controlling the organ is required, and it will be useless to attempt to do so by holding it between the fingers, or even with a towel. The best plan is to hook the tongue with a tenaculum and draw it out from the mouth, when the ligature and the suture may be applied and their ends cut close off, after which, the tenaculum being removed, the tongue may be returned into the mouth. In some cases it has been recommended to pass a needle and ligature through the end of the tongue for the purpose of controlling it, but the tenaculum is quite as efficient, and not so painful. Neglect of decided measures, from a mistaken tenderness in these cases, has been the cause of much of the trouble that has sometimes arisen in cases of wounds of the tongue.

If, after the tongue is returned to the mouth, it should swell much, or should inflammation come on, cold applications and antiphlogistic measures, especially purgatives, must be resorted to.

7. Extensive wounds involving the **Jaw-Bones** and creating compound fractures, present a class of injuries that can only be alluded to in a general manner, as their extent varies greatly, and their treatment will be given in connection with fractures. Their prognosis is, however, usually favorable, large portions of both maxillæ having been removed by cannon-shot, and the patients recovered. One patient, whose lower jaw was shot away, at Wagram, under Napoleon I., lived forty-eight years in the Hôtel des Invalides, at Paris, wearing a silver mask to collect the saliva and keep his

tongue and mouth from being exposed to changes of temperature. Guthrie reports fifteen patients in this hospital wearing similar masks.

In the case of a soldier of the 84th Regiment, Pennsylvania Volunteers, wounded at Winchester, Virginia, a Minié ball at short range struck the right side of the jaw, about half an inch posterior to the anterior mental foramen, and came out at the chin, fracturing and splintering badly about one inch and a half of the bone, dividing the genio-hyoid muscle, and allowing food and saliva to escape from the wound. Under the use of Barton's bandage and the cold water-dressing, he is now much improved, (fifteen days after the injury,) at St. Joseph's Hospital, Philadelphia.

In all extensive wounds of the face involving the cavity of the mouth, too much care cannot be exercised to prevent the blood being swallowed, and hemorrhage thus concealed, as well as in preventing the discharges from suppurating wounds passing into the stomach. In summer great caution is also necessary to keep (by means of gauze) the flies from laying their eggs in the wound and thus generating maggots. In a patient, who many years since attempted suicide by placing the muzzle of a gun under his chin, and discharging the load so as to blow away his mouth and face, maggots were found in the nasal cavities and stomach after death, and doubtless favored a depressed condition of nutrition as well as extreme irritation. The injection of a weak solution of creosote, two drops to the ounce of water, and careful nursing, will do much toward their removal.

When wounds of the face have been created by pointed instruments, the latter should, if possible, be examined as well as the wound, lest a portion of the instrument remain imbedded in the bone, and subsequently act as a foreign body. When limited portions of the bones of the face are splintered, it is better to allow them to remain, especially if covered by their periosteum, the reparative power of the periosteum being very marked in a region like this that is well supplied with blood-vessels—the experiments of Ollier having shown that the periosteum alone will reproduce bone under almost any injury when its vitality can be maintained. In the removal then of such portions of the maxillæ as the wound sometimes demands, care should always be taken to leave the periosteum, that its influence on the new formation may tend to diminish the deformity as well as add to the ability of the patient in mastication.

## SECTION III.

### WOUNDS OF THE NECK.

**General Remarks.**—**Wounds of the Neck** vary greatly in accordance with their seat, their depth, and the character of the cause that creates them; thus wounds of the front of the neck involve more vital structures than those on the back of this region; while the deeper the wound penetrates, the more it approaches important organs. The size and character of the superficial vessels of the neck, as well as the necessity of preserving free motion in the part, sometimes render superficial wounds serious by the subsequent contraction caused by the cicatrix. Superficial wounds of the neck are also occasionally followed by such inflammation and suppuration as threatens life by the burrowing of pus into deeper parts, especially under the reflections of the cervical fascia. Wounds of the neck, as a class, are not, however, so fatal as might at first be thought; only 4 out of 128 having died, as reported by Macleod, in the Crimean war.

1. **Punctured wounds of the neck** are liable to be complicated by the

presence of a foreign body, which, being implanted in the vertebræ, subse-
quently becomes a cause of great inflammation and suppuration; thus I saw,
in Paris, a sharp foil broken off in the body of the fifth cervical vertebra of
a medical student at La Charité, and its presence not detected until the
long-continued suppuration led to a suspicion of its position.

The *hemorrhage* that supervenes on punctured wounds of the neck, when
large vessels are opened, is so excessive that unless assistance is promptly ren-
dered, death quickly supervenes—as in wounds opening the carotid artery,
internal jugular vein, etc.—though occasionally patients have recovered after
wounds of the carotid, an example of which I saw recently in a patient re-
siding near Norristown, Pennsylvania, who, fainting after a wound that
divided his carotid artery, recovered without the application of a ligature.

*Emphysema* is also a frequent attendant on these wounds, when they
open the trachea or larynx, owing to the constant motion of the skin in res-
piration, especially if the wound of the skin is smaller than that which is
deeper seated, or the two do not subsequently correspond, as when the wound
is made with the neck extended, and the patient subsequently remains with
it flexed or semiflexed.    The emphysema, under such circumstances, will
sometimes extend over the entire body.    Its arrest is to be obtained by ren-
dering the superficial and deep wounds parallel, and by punctures, pressure,
etc., as before advised for the relief of emphysema elsewhere.

Punctured wounds of the nerves of the neck are followed by similar results
as wounds of nerves in other portions of the body—that is, the distant parts
supplied by these nerves are deprived of motion and sensation, and as the
nerves of the neck are of great importance, their wounds are usually followed
by serious results.    Thus the division of the phrenic, par vagum or descendens
noni, would be followed by the destruction of the function of the parts to
which they are distributed.    Injury of the *pneumogastric* creates violent
oppression, spasm, and death; that of the *recurrent laryngeal*, loss of voice
that is often persistent; while the injury of the sympathetic or phrenic in-
duces death by convulsions.    Paralysis of the arm and hand also sometimes
follows such wounds of the neck as involve the cervical origins of the axillary
plexus.    Punctured wounds of the back of the neck, involving the spinal
marrow, will in like manner create most serious symptoms; and should the
puncture be made through the occipito-atloidean space, death would instantly
ensue from the destruction of the function of the medulla oblongata.

**2. Incised wounds of the front of the neck** are much more frequently
seen than the preceding class, owing to the suicidal attempts often made
by lunatics.    The prognosis of these wounds depends very much on the
position and extent of the incision.    As most men are right handed, and the
impression is wide spread that opening the trachea is fatal, most suicidal
attempts create incised wounds near or above the larynx, without involving
the large vessels and nerves, or causing much hemorrhage.    Then, again,
those desirous of opening the carotid artery usually attempt it before a look-
ing-glass, in consequence of which the head is so much turned round that
the belly of the sterno-cleido-mastoid muscle covers the vessels, and serves
to protect them, though the external jugular vein is often thus opened and
bleeds freely.

In some rare cases patients have turned the head so much, and cut so high
up, that the vertebral artery has been divided; and the question has been
raised in courts of justice, whether such a thing was possible, as between
the atlas and vertebra dentata this artery is curved so that an incision *might*
wound it.    Although, then, such a wound is possible by the patient, it is more
probable that when met with, it has been made by another person, and if this

is corroborated by additional circumstances, it would be a link in the chain of evidence against suicide.

The treatment of incised wounds of the neck will necessarily vary much, but the indications are to arrest the hemorrhage promptly, close the wound, prevent emphysema, and secure perfect union of the parts. These indications may be fulfilled in various ways, the arrest of hemorrhage being secured by acupressure, as detailed in page 193, or by promptly ligating the vessel in the wound or on its main trunk of the artery, as hereafter stated in vol. ii. In a slight opening of the internal jugular vein, compression at the wound, by encircling with a ligature the coats at the side wounded, may be tried; but if the vein is cut across, both its upper and lower ends should be ligated, taking care not to include the par vagum nerve in the ligature. Hemorrhage from the external jugular vein may be checked by judicious compression, or, if necessary, by the ligature. In any case where the wound admits of it, acupressure may be advantageously resorted to, the vessel being constricted on the needle by a figure of 8 ligature, as in the hare-lip suture. When the wound is situated above the larynx and below the os hyoides, the pharynx being opened, food and drink will escape by the wound, or flow into the larynx when introduced into the mouth. When the wound is situated lower down, this is not the case, except the œsophagus has been opened, and this is rare.

After the arrest of hemorrhage, the first point is, to notice accurately the character of the wound, and close it by silver sutures so as not to include any portion of the tracheal mucous membrane, the neck being placed in that position which is most natural, and can be most readily maintained by some of the bandages before described, page 138, or seen in Fig. 192.

Care should also be exercised in feeding the patient, to resort to the use of the stomach-tube whenever food or drink escapes by the wound. For this operation, see vol. ii.

Union of these wounds by the first intention is, however, rarely obtained, and attention is necessary lest the edge of the skin be so closely united by the suture that air, food, etc. escape into the subjacent tissues, and thus create extreme irritation. So marked is this in some cases that it is often best to leave the centre of the wound open as an exit for air and food. Throughout the treatment of these wounds the surgeon will often find it necessary to watch, lest his dressings be removed and a renewal of the suicidal attempt made, the best means of preventing which is by the constant presence of a faithful nurse.

Wounds involving the larynx or trachea are sometimes, like the operations of laryngotomy and tracheotomy, very difficult to heal entirely—a tracheal or laryngeal fistula remaining, thus causing loss of voice, etc., and being quite intractable. When such a fistula is temporarily closed by the finger or otherwise, the patient is often able to speak. Though difficult to cure, these fistulæ may be closed by repeated cauterization with the nitrate of silver, or by a plastic operation in which an adjoining portion of skin is slid over the wound or employed as a plug. (See vol. ii.)

In the general treatment of wounds that have opened the trachea, and especially in those above the larynx, the patient's comfort and ultimate recovery will be materially aided by close attention to his wants — thirst being allayed by morsels of ice placed upon the tongue and allowed to melt slowly; by keeping moistened gauze over the wound to maintain the moisture of the trachea; by anointing the nostrils and mouth with glycerin; by regulating carefully the temperature and hygrometric condition of the room; by regulating the action of the bowels by enemata; and by relieving pain, cough, and restlessness by the judicious use of anodynes. If fever is not

present, strong soups or milk-punch, given with the œsophageal catheter and a syringe, will prove the best nutriment; while if much blood has been lost, the liquid preparations of iron, bark, or quinine may also be thus given as demanded. In employing the stomach-tube its application should be as rare as possible.

Incised wounds of the back of the neck, as made with sabres, or contusions of this region, are sometimes followed by a train of symptoms not readily anticipated, from extension of the irritation to the cerebellum, viz., loss of the virile power, as in the case of the dragoon cited by Hennen, who, though previously remarkable for his amours, lost all desire and suffered atrophy of the testicles on the receipt of a sabre cut of this region. Counter-irritants to the spine, the administration of mercurials until the gums are slightly touched, and the employment of an electrical current from the spine through the organs will be the appropriate means of counteracting such a condition.

Fractures of the os hyoides, larynx, or vertebræ, as the result of wounds, will be referred to hereafter.

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# CHAPTER X.

## WOUNDS OF THE CHEST.

**Wounds of the Chest** are dangerous or otherwise, according to their extent and character; that is, accordingly as they involve the interior, or only the superfices or parietes of this region.

For this reason they are usually classified as penetrating or non-penetrating wounds, either of these groups including the varieties created by different causes, as gunshot, incised, punctured, etc.

## SECTION I.

### NON-PENETRATING WOUNDS OF THE CHEST.

**Non-penetrating Chest Wounds** do not pass deeper than the exterior of the pleura, and will offer but little that differs from the class of incised, punctured, and lacerated wounds in other regions except that which is due to the anatomical relations of this region and the mechanical action of the chest; hence it is important, even in the apposition of the edges of any superficial wound of the chest, to aid the means of union by such sutures, plaster, etc. as will prevent the union of the edges being disturbed by the stretching of the integuments in a full inspiration. In wounds involving the pectoralis or serrati muscles the arm on the injured side should also be maintained in a sling. In extensive non-penetrating wounds, the liability of the extension of inflammation to the pleura and lungs should be met by the employment of opiates and arterial sedatives. Contused wounds of the chest, though apparently slight, are very liable to be followed by internal inflammation, in consequence of the concussion of the thoracic contents by the force that creates the blow. In the contusions frequently seen in railroad injuries, or from compression by other causes, this is especially noticeable.

Superficial or non-penetrating wounds of the chest present varied symptoms in accordance with the extent, position, and character of the injury—as hemorrhage, presence of foreign bodies, emphysema, and inflammation, each of which demands special consideration. *Hemorrhage*, in these wounds, may come from any of the branches of the external mammary arteries, or from the intercostal or internal mammary, though the latter are most apt to be injured by penetrating wounds. It must, however, be recollected that in their normal position both may be injured, without perforation of the pleural cavity, simply by laceration. In punctured wounds of the exterior of the chest, the hemorrhage is often free, and as the thoracic areolar tissue is loose, bloody tumors and ecchymosis of considerable size will sometimes be met with, extending from the axilla to the pelvis, especially when a large arterial branch has been punctured. In these cases, if pressure fails, and especially if a thrombus forms, it may become necessary to enlarge the wound, ligate or arrest by acupressure the bleeding vessel, and turn out any clot of blood that is effused, in order to prevent extensive suppuration; but when pressure will arrest the bleeding, the wound should be closed promptly in order to prevent the access of the atmosphere, the absorption of the effusion being favored by moderate compression and as perfect rest of the part as is possible. Except when the line of the wound involves the axillary artery or vein, the thoracic parietes will be found to offer so firm a basis of support that a graduated compression, by compresses fastened down by a bandage or adhesive strips, will suffice to arrest it.

*Emphysema* or infiltration of the subcutaneous areolar tissue by the atmosphere is a frequent attendant in non-penetrating thoracic wounds, especially when the opening has a valvular character or the wound runs obliquely. In accounting for its production the explanation offered by Petit is yet, generally, received as correct, viz., that when the wound is caused by an instrument that glances between the muscles of the chest and the ribs into the free areolar tissue there found, the movement of the ribs in expiration creates a cavity, and permits the pressure of the atmosphere to force air into the wound through its orifice. When subsequently, in inspiration, the orifice collapses, the inclosed air is forced onward by the contraction of the exterior covering of the thorax until it may create very great distention, new air being introduced and its escape prevented by closure of the wound at each alternate movement of respiration. As this air is stimulating it may induce free suppuration, or so distend the integuments as to create inflammation of the skin, with subsequent erysipelas and sloughing. Numerous punctures through the integuments may be demanded to prevent distention and sloughing, otherwise closure of the orifice of the wound and pressure will suffice.

The *inflammation* of superficial chest wounds resembles that seen in the soft tissues elsewhere, the free areolar tissue predisposing, however, to the creation of an abscess. If the exterior inflammation is extended, or of a high grade, pleurisy or pneumonia may supervene, and should be treated on general principles.

Inflammation of the interior of the chest, consequent upon an external wound, is easily explained through the free distribution of the vessels and nerves of this region, which, coming from a common trunk, are distributed on the pleura, diaphragm, and skin through the intercostal spaces. Hence the value of cups, blisters, fomentations, and sinapisms, when applied to the surface of the chest for the relief of internal inflammations.

In some instances inflammation and injury of the thoracic organs supervene on concussion or contusion of the chest, in consequence of the transmission of the force developing an injury in them; thus a blood-vessel may

be ruptured, and the patient spit blood, as the result of a contusion of the chest, without any wound at all.

*Foreign bodies* in non-penetrating wounds may be bullets or instruments broken against the ribs, or portions of clothing. In all cases they should be removed as promptly as possible, as they are additional sources of irritation. In some cases long-continued suppuration is thus maintained, and this may be accompanied by caries or necrosis of the rib.

Wounds of the posterior portion of the chest are less liable than those at the front and sides to be followed by the symptoms of hemorrhage and emphysema. When, however, they penetrate the fascia of the dorsal muscles, the subsequent suppuration, if they inflame, should be early evacuated, to prevent the burrowing of pus. Contused wounds of this region may also create concussion of the spinal marrow, and subsequent paralysis or interruption of the function of this organ.

The mortality of simple non-penetrating chest wounds is usually not great, as Macleod reports only 3 deaths out of 255 cases of gunshot wounds of the soft coverings of the chest, in the Crimean war; and of 24 cases involving the bony, cartilaginous, or intercostal tissues, only 1 died. But when complicated, non-penetrating wounds are often serious, lesion of the thoracic contents taking place 16 times, with 9 deaths, as reported by Macleod, although in these cases the ball did not penetrate the thoracic cavity.*

*Difficulty of respiration* is also sometimes an attendant on non-penetrating chest wounds, from a temporary paralysis of the respiratory muscles, consequent on the concussion, especially of large shot.

*Dyspnœa, emphysema,* and *hemoptysis* may then, it is admitted, be all present in superficial or non-penetrating wounds of the chest, though at one time these symptoms were regarded as certain evidence of penetration and of lung wound. When present in superficial wounds, they should be treated on the principles applicable to them when due to penetrating wounds, as will be subsequently stated.

## SECTION II.

### PENETRATING WOUNDS OF THE CHEST.

By **Penetrating Wounds of the Chest** are usually meant either those that open the cavity of the pleura or wound some of the thoracic viscera, as the lungs, heart, and blood-vessels. As all these are very vital organs, penetrating chest wounds have been carefully studied by surgeons from an early period, and their dangers predicated on the extent and character of the hemorrhage, and their direct or subsequent interruption of the respiratory function.

As it has been already shown that non-penetrating wounds of the chest also produce many symptoms of derangement of the respiration and circulation, the first point to be settled is the evidence of the chest wound having penetrated the thoracic cavity, and this has recently been the subject of careful study by Surgeon Frazer, in connection with the Crimean war,† as well as tested in various experiments upon animals by different surgeons. In the United States these results have been confirmed by the experiments of Draper, of Delaware, in an inaugural essay, as hereafter shown.

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* Op. citat., p. 202, Phila. ed.
† Treatise on Penetrating Wounds of the Chest, by Patrick Frazer, M.D. London, 1859.

**Diagnosis of Penetrating Chest Wounds.**—It is well known that in normal respiration a cavity is created in the chest by the action of the respiratory muscles, and that the pressure of the atmosphere then forces the air through the firm patulous larynx and trachea into the lungs, the air-cells of which being thus dilated, aeration of the blood is accomplished during inspiration. In this process, the lung is thoroughly distended and made to approach the walls of the thorax. The chest being then contracted, compresses the pleural cavity, and being aided by the parenchymatous contraction of the lungs, the air is expelled and expiration finished, the lung collapsing toward the vertebral column, or the attachment known as the root of the lung. When by a wound of the parietes of the chest the thoracic cavity, that is normally a closed sac, is opened, a mechanical force is brought by the entrance of the atmosphere to bear upon the *exterior* of the lung, which previously only felt it indirectly through the thoracic parietes, the latter affording an excellent resistance thereto.

All penetrating chest wounds have therefore generally been regarded as serious in proportion to the amount of the atmosphere admitted into the chest, or from the hemorrhage. It will, however, be very apparent that if the opening in the parietes of the chest is small, the atmosphere can only have slow access, its weight there being resisted by the larger amount of air passing through the larger orifice of the larynx, and hence that until the pleural cavity is pumped full of air the lung will be somewhat distended by the force of that which entered it through the trachea, that in the chest being driven out to some extent. Collapse of the lung does not therefore invariably follow on penetrating chest wounds, nor will it, unless the thoracic orifice, if small, is kept open, or if large, is larger than the orifice of the larynx. If larger than the larynx, collapse of the lung will promptly occur, because the weight of the atmosphere exterior to its surface will then be greater than that introduced to its interior through the trachea. Commencing with a reference to this general physical phenomenon, we will now the more readily comprehend the diagnostic signs of penetrating chest wounds.

As essential to a correct diagnosis of these wounds, we must carefully examine the symptoms assigned to them, and these are very varied, so much so that nothing but the direct use of our senses, as in seeing the cavity or touching it, can leave us without doubt as to the fact.

Certain ideas gained from other sources will, however, aid us in making a diagnosis. For example, the size and character of the weapon and its course may lead us to presume that it entered the thoracic cavity, yet this is only presumptive evidence; many instances being known where the chest has been apparently transfixed without its cavity being really opened, as in cases cited by Dupuytren, Hennen, Ballingall, and many other military surgeons, as well as proved by experiments on animals—the pleura costalis apparently possessing a certain resiliency that will permit a ball or other weapon to remove it from the parietes of the chest without its being injured. Hence bullets have traversed the chest and not perforated the pleura, while swords, bayonets, pikes, scythes, etc. have passed so obliquely as apparently to traverse the chest and yet in reality pass only beneath its muscles—an instance of which is cited in Van Swieten's Commentaries. A reference to Eve's valuable collection of cases* will show many others. Among the most remarkable of these is that of the brave General Shields, who, in Mexico, had a grape-shot to traverse his chest—the ball, according to Eve, passing *between the lungs, through the mediastina,* entering within the right nipple

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* A Collection of Remarkable Cases in Surgery, by Paul F. Eve, M.D. Nashville, 1857.

and passing out near the spine on the right side.* This well-known soldier has recently been wounded by a passing shot, at Winchester, that broke his humerus. In another case, reported by Blanton, of Frankfort, Kentucky, a grape-shot passed through the chest; blood and air escaped freely from between the second and third ribs, yet the patient recovered. Sixteen months subsequently he weighed nearly two hundred pounds, and, dying suddenly, a post-mortem examination showed the left lung entirely collapsed and covered by dense bands, in cutting which the ball was found between the spinal column and the end of the fifth rib. The ball was of bell metal, and weighed four ounces and five grains. With it there was found a brass button that weighed nearly two drachms, both of which were encysted. The pericardium was entirely agglutinated to the heart.

Tromatopnea, or the escape of air from the orifice of the wound, is another of the signs formerly given as evidence of penetration; but we have already seen that this may be present in non-penetrating wounds as the mere result of the mechanical action of the ribs. Another test is to close the orifice of the wound and cause the patient to take a full inspiration, and then, while holding his breath, with his glottis closed, to make an effort as in expiration, while, at the same time, the surgeon applies the flame of a candle to the orifice in the chest that he had previously closed. If air escapes, this certainly is a proof that it was in the chest, but if it does not, the cavity of the chest might yet be open, but the non-escape of the air be due to the oblique course of the wound, or to a plug of adipose tissue closing the orifice, or to a change of position, destroying the continuous line of the wound originally.

Emphysema may be caused by a wound that penetrates the lung; but as it has already been shown to be an accompaniment of non-penetrating wounds of the chest, it has no certain diagnostic value.

Dyspnœa is also a most fallacious symptom of penetration of the chest, as it may ensue upon the shock of injury, be present simply from emphysema, and absent when the chest is penetrated. Surgeon Frazer† has seen intense dyspnœa with a free action of the thorax, but without wound of the thoracic cavity; while in a collapsed lung, without opposition to the entrance of air into the other, dyspnœa was not present. Out of nine cases that he reports in which the lung was wounded, only three had dyspnœa. In not one of the dogs that he experimented on with lung wounds was there any dyspnœa.

Owing to the extreme vascularity of the lung and the free ramification of the bronchial tubes, it would seem difficult to wound the lung without giving rise to hemoptysis, or spitting of blood. The expectoration of a very bright, frothy blood, mixed with air, was therefore once thought to be a positive sign that the lung was wounded. Yet cases have been reported by Petit, Gerdy, and others, in which penetrating wounds of the lung, as proved by post-mortem examination, had been unattended by hemoptysis, the instrument inflicting the wound having escaped the bronchial tubes, and of course prevented the expectoration of the blood. It is also well known that the lung is occasionally so injured by compression as to create hemoptysis without there being any wound at all of the chest. From this it is evident that neither the character nor the apparent course of the instrument creating the wound, nor probing, nor the escape of air externally, nor emphysema, nor hemoptysis *alone* can be regarded as a positive sign of a penetrating wound of the lung.

The accurate diagnosis of penetrating wounds is therefore a matter of extreme difficulty, and nothing but a wound of such size as enables the surgeon to see into the chest or to touch the interior with his finger can be

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* Op. citat., p. 202; Eve, p. 204. † Op. citat.

relied on. Fortunately, a correct diagnosis in a medico-legal question can generally be made by a post-mortem examination, while in the treatment an accurate knowledge of the extent of the injury avails less than is generally the case; the symptoms and complications requiring to be met as correctly as circumstances indicate. As a general rule, every penetrating wound of the chest should be promptly closed without probing, and an effort made to convert it into a non-penetrating wound, the complications that may result from this course being met as subsequently directed.

In the present condition of our knowledge, with the well-known opinions of Guthrie, Lawrence, Ballingall, Macleod, and others, on the value of hemoptysis, dyspnœa, and emphysema, as *certain* signs of wounds of the lung, are we justified in doubting the correctness of the symptoms hitherto assigned as evidence of chest wounds, especially as some of them have been maintained by the profession since the days of Galen? Undoubtedly we are, if new facts and observations create a just distrust, even when such opinions have stood for centuries; and these facts are now, I think, of sufficient value, especially when corroborated by or in accordance with anatomical and physiological facts, to give them a positive character. Thus Frazer gives* a tabular statement of the symptoms seen in thirty cases of lung wound, with the days on which they occurred, and a table of twelve fatal cases, with the post-mortem appearances, and also one of nine that recovered.

Of the latter 9, dyspnœa was present only in 1 case; hemoptysis, in 4; emphysema, in 2; pneumonia, in 3; and air escaped externally only in 1. Analyzing then his facts, we find dyspnœa present in 4 of 12 fatal cases, and in 1 out of 9 that recovered, while it was not present in any of his experiments on dogs.

Hemoptysis was not present in a case, the preparation of which, in the museum of St. George's Hospital, London, shows a laceration of the lung four inches long, two deep, and gaping, one inch, the patient dying on the eighth day. In 9 fatal cases of lung wound, hemoptysis occurred only in 1; while 7 fatal cases without lung wound, spat blood. In none of the dogs experimented on was there any hemoptysis. Emphysema occurred in 4 out of 18 fatal cases, in 3 of which the lung was wounded, and in 1 out of 12 cases that recovered. It did not occur in any of the dogs experimented on.

Pneumonia, he says, may be, but is not a *necessary*, consequence of lung wounds; in not one of 9 fatal cases in which the lungs were wounded did pneumonia supervene; while in 1 out of 9 fatal cases in which the lungs were not wounded it appeared. It appeared in 2 out of 12 cases of recovery, while in 12 fatal cases reported from another source, he says it was present in 7; also in 3 cases out of 9 that recovered, as reported by the Director-General of the army.

Pleuritis, once thought to be a frequent result of penetrating wounds of the chest, Frazer regards as an occasional but not usual consequence. The lymphy deposit observed after death is not, in his opinion, similar to that seen in idiopathic pleurisy, but rather, as thought by Hunter, merely evidence of the efforts of nature to repair the damage. This lymphy deposit, when scraped off, showed an uninflamed pleura in several instances, though in some the effusion of sero-sanguinolent matter was free.

In order to test the value of the experiments cited by Frazer, I recently requested my former pupil—now Dr. Draper, of Delaware—to repeat them, which he did, publishing the results,† and verifying most of them. His results were as follows:—

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"1. The lung does not collapse immediately when the pleural cavity is opened, unless the opening in the chest be larger than the glottis.

"2. Collapse, if ultimately occurring, takes place in a period proportioned to the size of the opening.

"3. Collapse does not follow *wound of the lung*, unless the opening in the walls of the chest be of sufficient size to induce it.

"4. Profuse hemorrhage seldom follows a wound of the lung, unless large.

"5. Pneumonia does not supervene on wound of the lung, unless there is a tendency to inflammation from other causes.

"6. Pleurisy is a rare result, except as a local affection that is limited around the point of injury.

"7. Air does not cease to pass at the wound when the lungs are wounded, and collapsed, escaping then mechanically from the pleural cavity by the action of the chest.

"8. Uncomplicated lung wound will generally heal without suppuration."

In thus offering to the reader this summary of recent observations on this important class of wounds, I am not prepared to declare that I look upon them as positive, though I certainly attach sufficient importance to their results to regard all the former reported symptoms of penetrating wounds of the chest as doubtful, and nothing as *certain* except that which is seen or felt. One point suggested by these results is certainly remarkable and well worthy of further consideration, viz.: that the pleurisy and pneumonia of penetrating wounds of the chest is not an inevitable result of the same character as idiopathic pleurisy and pneumonia. In traumatic pleurisy, the lymph met with is reparative, and in the circumscribed pneumonia it is the same. In the latter there is also not the extended tendency to disorganization that is met with in idiopathic pneumonia, where we often note a train of symptoms of a typhoid character that is not seen after wounds of the chest unless intemperance, scurvy, or some similar cause has modified the condition of the blood.

It yet remains to notice the complications attendant on penetrating wounds of the chest.

**Internal** or **concealed Hemorrhage** may be seen in penetrating as in non-penetrating chest wounds, being much more frequent in penetrating wounds. It may arise from a wound of the intercostal artery, or some of the branches of the pulmonary, or from some of the other thoracic arteries and veins, attended by a free external wound. When free, external hemorrhage ensues upon that which has filled the thoracic cavity to the level of the wound, whence it escapes. In this case the lung will probably be collapsed or compressed.

The symptoms of concealed thoracic hemorrhage vary somewhat with its extent, and the space into which the blood may flow. Usually the face is pale, the pulse small and quick, and there is cold sweat, dim vision, difficult sighing respiration, and all the usual symptoms of internal hemorrhage elsewhere. Mensuration will sometimes show a fullness of the chest on the wounded side similar to that produced by pleuritic effusion. The patient will also breathe most readily when the chest is somewhat elevated, suffocation threatening if he lies down on his back or on his sound side. Percussion will exhibit the dullness of thoracic effusion, and the respiratory murmur will be accompanied by gurgling, or heard only at the upper part of the chest, to which the lung is floated.

**Pneumatocele**, or **Hernia of the Lung**, is another complication sometimes met with, the diagnosis being usually easy, as the tumor may be seen,

or, if beneath the skin, enlarges on an inspiration and gives a vesicular murmur.    In one instance, I have met with a hernia pulmonalis that followed a wound of the top of the pleura and formed a tumor on the side of the neck as large as an adult fist; in another, a portion of the size of a hen's egg protruded through the fifth intercostal space, both yielding readily to compression.

**Foreign bodies** introduced into the chest often constitute a serious complication of penetrating chest wounds, and vary greatly, consisting of bullets, points of bayonets, and pieces of clothing, or the accoutrements of the soldier, or articles carried in the pocket, as the watch.    Of these, some are buried in the soft parts, but others penetrate the chest, and have even been buried in the vertebral column.

**Inflammation and Suppuration.**—The inflammation that results from penetrating wounds of the chest is apparently much less frequent and extensive than was formerly supposed, general pleurisy or pneumonia being rare, as shown by Frazer and Draper, as before cited.    When inflammation is developed, its tendency is usually reparative, and should not therefore be checked, unless in a bad constitution, or the result of other causes than the wound.

**Empyema,** or a collection of pus in the chest, is usually the consequence of a previous effusion of blood, or of the irritation caused by a comminuted fracture of the ribs, or the presence of foreign bodies in the thoracic cavity. Its diagnosis is easy when the wound permits the escape of the pus externally, otherwise its presence can only be surmised by the usual evidences of liquid effusion in the chest, by percussion, or by the reappearance or increase of dyspnœa, or the continuance of hectic fever, accompanied by more or less pain in the side.    Valentin has suggested that an œdematous condition of the base of the thorax near the false ribs is a certain sign of empyema, but though sometimes present, Larrey thinks its value limited.    If the empyema is allowed to continue, its increase may cause death by asphyxia, but sometimes the pus is voided by the natural reopening of the chest wound, or a spontaneous opening may result from the intercostal distention, as in abscesses, or it may be absorbed.    To expedite the cure, or give temporary or permanent relief, thoracentesis may be demanded, as described in vol. ii.

**Fractures of the Ribs and Sternum,** as the result of chest wounds, are serious complications, amenable, however, to the treatment of compound fractures of these bones, as hereafter described.

**Prognosis.**—The prognosis of penetrating wounds of the chest depends upon the character and extent of the wound, the hemorrhage, and the strength of the patient in sustaining the reparative process.    Many chest wounds are quickly fatal, yet many of the most discouraging character ultimately recover, as in that of General Shields, before alluded to.    The prognosis, under all circumstances, is, however, serious, and the recovery uncertain, old adhesions of the pleura materially modifying the result.    Then as the actual character of the injury is to a certain extent necessarily surmised, the result must be doubtful.    Guthrie states that more than half of those shot through the chest die.    The mortality in the Crimea was not so marked, Macleod reporting 107 cases of wounds that penetrated the chest without injuring important organs, and of these only 10 died; of 44 accompanied by important lesions, 3 died.    Hennen states the general principle that the chief cause of death is the hemorrhage that ensues, and that if the patient survive the third day—Macleod says twelve or forty-eight hours—hopes may be entertained of his recovery, the danger subsequently consisting in the inflammation developed by the foreign body.    Wounds of both lungs are almost invariably fatal, though cases of recovery are recorded.

**Treatment.**—The treatment of penetrating chest wounds must be both local and constitutional, and be governed mainly by the circumstances attendant on the injury and its complications.

**Local Treatment.**—It is a principle long debated and not positively settled, whether penetrating wounds of the chest should be promptly closed, the majority siding with those who advocate their immediate closure as soon as foreign bodies in the thoracic parietes or external hemorrhage have been arrested. Guthrie, who is excellent authority, lays it down as a principle that the wound should be closed. If it is not, the cavity of the pleura passes into a state of suppuration.* Should the hemorrhage be internal and blood be effused into the pleura, Macleod is in doubt whether Valentin, Larrey, Sanson, and Dupuytren were right in supposing that the retention of the blood could, by pressure on the wound in the lung, arrest the bleeding. He rather advocates the enlarging of the external wound, so as to allow the blood to escape.† In the removal of foreign bodies from the parietes of the chest, forceps usually are necessary, care being taken to create as little additional irritation as possible. The ligation of external arteries in the lips of the wound is also to be accomplished in the usual way, the wound, if requisite, being enlarged in order to secure them. Wounds of the intercostal artery are best treated by direct ligature, the intercostal muscles, if necessary, being cautiously opened and the artery exposed. The various plans of Reybard and others, of compressing the artery against the rib, are only applicable to very free wounds that expose the ribs. Macleod says, in reference to wounds of this artery, that he neither saw nor heard of a case during the war in which an intercostal artery was opened.‡ All attempts at minute probing to learn the course of the wound, or of cups and suction to withdraw air or blood from the thoracic cavity, are of doubtful utility—the only probe at all admissible being the finger, and this should be used with great gentleness. The sooner the atmosphere is excluded by closing the wound the better, and this is best accomplished by uniting the lips of the wound by sutures supported by adhesive strips, and then subsequently reopening a point of the wound, should extravasation into the pleural cavity require it. In order to favor the union, the chest should be kept at rest as much as possible, by the patient abstaining from speaking as well as by the treatment employed in fracture of the ribs, a full dose of opium securing sleep, and diminishing the frequency of the respiratory effort, the dressing being renewed as seldom as possible. The dressing in this case should be by means of broad strips of adhesive plaster passing from the spine to the sternum, and not the spiral bandage of the chest formerly resorted to, for, as Macleod says, "men wounded in the lungs require all the breathing space we can give them, and this is best managed by having the sound side free."§

**Constitutional Treatment.**—As the arrest of hemorrhage is of the first moment, the general means of regulating the circulation must promptly follow the local treatment of chest wounds. Internal hemorrhage, as before stated, comes either from a wound of the lung or of some of the large blood-vessels.

In either case the application of a ligature is impossible; hence general means must be resorted to, to diminish the heart's action, induce syncope, and favor the formation of a clot in the wounded vessels; and the best means of accomplishing this is certainly by venesection, carried ad deliquium animi. The explanation of the arrest of hemorrhage by the further abstraction of blood is to be found in the syncope that is induced and the solidification of the blood

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* Commentaries, Phila. ed., p. 419.
† Surgery of Crimean War, Phila. ed., p 218.        ‡ Op. citat., p. 208.        § Op. citat.

clot at the seat of injury. Having by a decided bleeding induced sedation, such means should be promptly employed as will maintain it for some hours, as the administration of the tincture of aconite, of veratrum viride, or the preparations of antimony. All motion of the patient should also be prevented, the slightest effort often sufficing to re-excite hemorrhage. As the irritation of the wound sometimes induces a tickling cough, this should be checked by anodynes, while cool drink, or ice in moderate quantities, should be all that is swallowed for the time. When after the first venesection the bleeding is checked and the pulse, notwithstanding the arterial sedatives, rises to anything like reaction, the venesection should be repeated. Whatever may be the ideas of the present day in reference to blood-letting in the treatment of inflammation generally, few surgeons will, it is thought, hesitate as to the absolute necessity of free venesection for the arrest of hemorrhage and the local congestion consequent on wounds of the lung. When the reparative action commences, an entirely different course may be demanded; but for the first three days after lung wounds the antiphlogistic system must be vigorously pursued.

After the second or third day inflammatory action in the chest may be anticipated, and must be met as the other complications before alluded to.

**Pneumatocele, or Hernia of the Lung,** may supervene on chest wounds, or be present from the first. If promptly seen, judicious manipulation and well-adjusted pressure, with closure of the external wound, will often enable the surgeon to overcome it. But when this cannot be done, it is safer to trust to the efforts of nature, and leave the protruding portion to inflame and slough off, than to ligate it or excise it, though both these plans have been advised and both followed sometimes by free pulmonary hemorrhage. Guthrie says that the lung should not be *completely* returned, as more inflammation follows than would otherwise be the case.*

**The removal, or after-treatment of foreign bodies,** is to be governed by general principles. If the foreign substance, as a bullet, has entered the chest and remains free, it may be possible by an appropriate position of the patient to favor its escape by the wound, though this seldom succeeds. As a general rule, foreign bodies had better be allowed to remain until suppuration is established, when thoracentesis may permit their removal with the pus; or their exit may be favored by washing out the chest with tepid milk and water, injected with a syringe, and then allowed to escape by the wound. During free empyema the injection of mild astringent or stimulating washes into the cavity of the chest will also sometimes prove useful.

Balls and other foreign bodies sometimes become sacculated and remain imbedded in the lung for years without causing irritation—of which there is an example in a preparation in the Wistar and Horner Museum of the University of Pennsylvania, where a piece of a shirt was imbedded in the lung, and subsequently exposed by adhesion of the lung to the ribs, with fistulous openings externally.

Other cases are cited by most writers on military surgery. At other times foreign substances leave a fistulous track in the lung that has indurated margins, and has only been known by its development months subsequently by post-mortem examination.

**Thoracic Fistulæ,** or those in the walls of the chest, not unfrequently supervene on gunshot wounds of the chest, and are generally the result of the presence of a spicula of necrosed bone, or some other irritant yet present in the wound. When its presence can be learned by probing, judicious efforts may be made to extract it, when frequently the fistula will heal under

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* Commentaries, Phila. ed., p. 457.

cauterization.    When a fistula exists in a patient exhausted and reduced to
a skeleton under the irritation of hectic, etc., every means that will augment
his nutritive forces should be employed, as iron, quinine, cod-liver oil, and
full diet, with fresh air and gentle exercise.

## SECTION III.

### WOUNDS OF THE HEART.

From the well-known importance of the heart it might be supposed that
its wounds would be promptly and certainly fatal, yet experience proves the
contrary.   In an excellent paper published* by S. S. Purple, of New York,
reference is made to forty-two cases of wounds of the heart, several of
which lived hours after the injury.    In the case of the boxer, Bill Poole, of
New York City, who was shot with a revolver, the ball lay imbedded in the
septum between the ventricles, so that four days after his wound he was
well enough to desire to fight again, but on the ninth day he died of peri-
cardial effusion ;† and in the case reported‡ by John Neill, of Philadel-
phia, a needle, two inches long, was found imbedded in the external wall of
the left ventricle, without having caused any inconvenience at first, and
never, during a year subsequently, presented urgent chest symptoms, though
troubled with occasional palpitation.

Many other instances of heart wounds, unattended by immediate death,
may also be found in Eve's valuable collection of Remarkable Surgical
Cases.

Indeed it would appear that wounds of the heart are not necessarily fatal.
Cases have been recorded in which, upon a post-mortem examination of
persons wounded in that region years before, cicatrices were found in the
walls of the heart.    There is also at least one apparently authentic case
recorded by Latour, in which a musket-ball was found in the right ventricle
six years after the reception of the injury.    The heart may also be *ruptured*
from severe blows, or contusions of any kind, without any wound of the
pericardium, or of the walls of the chest.    In these cases death generally
takes place instantaneously.    The *pericardium* may be wounded without
any injury of the heart.    This is by no means so fatal to life as when the
heart is directly involved.

**Symptoms.**—The symptoms of a wound of the heart are those of prostra-
tion, not only from loss of blood but also from nervous depression.    There
is faintness, great anxiety expressed by the countenance, a feeble and often
intermittent pulse, and labored respiration.    There may be great loss of
blood, and yet frequently the hemorrhage is but slight, as the muscular walls
of the heart may contract irregularly and spasmodically, so as to close the
wound and favor the formation of a coagulum    Within a short time after
the injury a friction sound, unless obscured by the presence of blood, will be
heard upon auscultation, this being due to the inflammation of the pericar-
dium, which necessarily ensues on the wound.    During this stage the wound
in the pericardium may close, and, if life continues, effusion of a serous fluid
occur, causing extended dullness on percussion, and diminution of the heart's
sounds on auscultation.

In wounds of the pericardium the prostration, feebleness and irregularity
of the pulse, and the dyspnœa, are all marked, but not so great as in the

* New York Journ. of Med., May, 1855
† Remarkable Surgical Cases, by Paul F. Eve, M.D., p. 228.
‡ Phila. Med. Examiner, 1849.

other case. There is but little loss of blood. Soon the friction sounds may be heard, then effusion of serum ensues, and the sounds of the heart become obscured, and the dullness on percussion is extended.

**Treatment.**—In *treating* wounds of the heart or of the pericardium reaction from the prostration should be procured, if possible, by the usual means, and then an attempt be made to lessen the inflammation that must follow, and to prevent its extension to the pleura and lungs; all foreign bodies should be removed and the wound closed. If great effusion of blood or of serum should take place into the cavity of the pericardium or of the pleura, so as to interfere seriously with the movements of the heart or with respiration, the wound may be opened again, or resort may be had to paracentesis thoracis or pericardii.*

## SECTION IV.

### WOUNDS OF THE GREAT VESSELS AND DIAPHRAGM.

Wounds of the **Aorta**, of the **Venæ Cavæ**, or of the **Pulmonary Artery** and **Veins** are generally fatal upon reception of the injury.

**Wounds of the Diaphragm.**—Particular attention has been called to these injuries by Guthrie, who states that these wounds are not immediately, although generally, fatal, and that, even if the patient lives, they will never, unless under rare and peculiar circumstances, close.

**Symptoms.**—The symptoms of these wounds are those of a penetrating wound of the chest or abdomen, with great difficulty in breathing.

**Treatment.**—In the treatment there is nothing peculiar, except that if the patient recovers he should be warned of the danger of diaphragmatic hernia and its possible strangulation. If this last should occur at any period, Mr. Guthrie urges an operation for its relief.†

## CHAPTER XI.

### WOUNDS OF THE ABDOMEN.

WOUNDS of the abdomen, like those of the chest, may be studied—1. As involving the parietes. 2. As penetrating. 3. As involving the abdominal viscera.

## SECTION I.

### WOUNDS OF THE ABDOMINAL PARIETES.

Superficial wounds of the abdomen differ but little in their character and result from other superficial wounds, the great danger connected with them being from the extension of the injury to the peritoneum and the subsequent development of peritonitis, a most serious complication. Contusions of the abdomen are especially apt to be followed by internal injury, the yield-

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* See vol. ii.    † Commentaries on Surgery of War, Phila. ed., pp. 458 to 464.

ing of the abdominal walls permitting violent concussion of the abdominal organs; hence it sometimes happens that what is apparently a simple contusion of the parietes or a gunshot wound of the exterior of the abdomen, is followed by death, in consequence of a rupture of the liver, spleen, kidney, stomach, or bladder, especially if the latter organ is full at the moment of injury, all being followed by more or less internal hemorrhage and marked evidences of collapse or by peritonitis.

Contused or other wounds of the abdominal parietes are therefore dangerous in proportion to the force that creates them, and the so-called wounds of the "wind of shot," or railroad concussions, or being compressed by the wheels of heavy vehicles, though leaving, as before stated, little or no evidence of external injury, are all thus sometimes promptly fatal, being accompanied by symptoms of severe shock.   Guthrie states that all severe contusions or wounds of the abdominal walls are liable to be followed by ventral hernia, and that this is universally the result when a musket-ball penetrates into or passes through the cavity of the abdomen.   In these wounds there is also sometimes seen a rupture of the fibres of a muscle, especially the rectus abdominis, which is followed by ecchymosis, tenderness, and tumefaction, any position that induces extension of the fibres of the muscle being followed by violent pain.   In order therefore to relieve the internal organs from pressure, patients injured in the abdomen are apt to take the semiflexed rather than the recumbent or extended supine posture.   For the same reason such a position should be insisted on in the union of wounds of this region.   Injuries of the abdominal parietes, if followed by inflammation and suppuration, are liable to result in sinuses and fistulæ from the burrowing of the pus beneath the aponeuroses of the muscles, though they generally open externally, and rarely into the peritoneal cavity.

### § 1.—Gunshot Wounds of the Abdomen.

**Gunshot Wounds of the Abdomen,** apart from the usual signs of contused and lacerated wounds, present frequently very tortuous wounds, balls being deflected by the linea alba, lineæ semilunares, transversæ, etc., so that instead of penetrating the abdominal cavity as might at first be thought, the wound is often superficial or limited to the abdominal walls.   A careful examination by the touch should therefore be made of the entire abdominal parietes in order that the foreign body, if imbedded, may be detected.   In all incisions of the abdominal parietes for the removal of foreign bodies, or in cases of suppuration, fistula, etc., the liability of the injury or of the incision to induce a disposition to hernia, should be recollected, and an opening made in such a direction (generally upward) as will avoid the usual tracks of inguinal and umbilical hernia.

Incised and punctured wounds of the abdominal parietes are amenable to the general laws of these injuries in other regions, care being taken, if they are to be closed, to unite them by the lead or silver suture, so placed as not to involve the aponeurosis, supporting the stitches, if necessary, by adhesive strips, but avoiding such bandaging as will tend to compress the abdomen, especially in cases attended by tympanitis.   Guthrie advises that, in wounds of the abdominal walls, except in the linea alba, sutures should only be passed through the skin, as he rarely found that the muscle united at all.   Where the wound is of a character likely to induce suppuration, it will be useless to close that in the skin; in this case as well as in contusions, it will be better to apply heat and moisture by means of hot-water cloths, covered by oiled silk or taffeta, and to keep this applied

as warm as is comfortable until the evidences of inflammation have disappeared. Few means of an apparently simple character are more efficacious in allaying abdominal irritation from almost any source than "stuping," or the warm water-dressing thoroughly and constantly employed for twenty-four or forty-eight hours, and especially as an addition to the usual treatment of peritonitis. If necessary, the dressing may be kept in position by an abdominal T-bandage (page 133) so applied as to permit distention by tympanitis if present. Wounds of the parietes of the abdomen caused by balls, that result in sinuous suppuration, are best treated by free counter-openings, and syringing the track of the ball.

Superficial abdominal wounds, though varying greatly, are usually very favorable as compared with penetrating wounds; thus, Macleod reports[*] only 17 deaths out of 101 simple and severe wounds and abdominal contusions, while of 38 penetrating wounds, 36 were fatal. Sixty-five cases of abdominal perforation produced 60 deaths.

Laceration of the kidney or bladder, as the result of injury of the abdominal parietes, will be often shown by bloody urine or the small amount of urine voided, while injury of the stomach is liable to be followed by hematemesis. In the female, the uterus, if impregnated, may likewise be ruptured by a blow or violent contusion.

### § 2.—Penetrating Wounds of the Abdomen.

By **Penetrating Wounds**, we mean those that open the sac of the peritoneum, without creating wounds of the viscera, the latter being referred to under a distinct head. These injuries are frequently met with as the result of incised, punctured, or gunshot wounds, the viscera, though in close proximity to the wound, escaping by their great mobility. When, then, in a penetrating wound, there is no special evidence of visceral injury, it may be taken for granted, as a general rule, liable, it is true, to exceptions, that the latter does not exist.

Penetrating wounds of the abdomen, without injury of the abdominal viscera, are, however, it should be recollected, very serious injuries; Macleod reporting, as before stated, 60 deaths out of 65 cases; Alcock, 18 deaths out of 19 cases; and Sedillot, reporting to have lost all whose abdomens were penetrated by gunshot.

**Prognosis.**—Macleod[†] states that the fatality of penetrating wounds of the belly depends much on the point of their infliction. Balls entering the liver, kidneys, or spleen are well known to be mortal, though exceptional cases are not rare. Wounds of the large intestines are less formidable than those which implicate the small bowels. Thomson saw only two cases of wounds of the small intestines, after Waterloo, in the way of recovery; but Larrey reports several. Gunshot wounds of the stomach are also exceedingly fatal, though Baudens records a remarkable recovery.

**Incised Wounds of the Abdomen** are those most likely to be met with as penetrating the cavity of the abdomen, as in the wounds created by sabres, bowie knives, etc. In this class of wounds, if the injury is of a moderate extent, there will generally be noted a tendency to a prolapse of the intestines, these being usually so acted on by the abdominal parietes that any wounds of the latter permit their protrusion. The intestines and omentum may protrude after such wounds in two conditions—1. As simply prolapsed, but reducible. 2. As irreducible from constriction.

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[*] Macleod, Surgery Crimean War, p. 227, Phila. edit.
[†] Op. citat., p. 230.

I. **Intestines protruding, but reducible.**—In treating such abdominal wounds as are followed by a protrusion of any of the viscera, the first object should be promptly to restore them within the cavity of the abdomen. In these cases it should be adopted as a general rule of practice that, before resorting to any incision of the parietes to facilitate the restoration of the protruded viscus, the surgeon should endeavor to replace it by manual means, aided by such a position of the patient, and use of anæsthetics, as will induce perfect relaxation of the tissues that form the anterior abdominal walls. Since the discovery of anæsthetics, the restoration of the intestines or omentum which have protruded through an abdominal wound is much more easily accomplished than was the case formerly. The following plan of treatment will, therefore, often succeed when there is no constriction of the protrusion.

**Reduction.**—Place the patient upon the back, with the shoulders elevated and the knees drawn up in order to favor the relaxation of the abdominal muscles, and then, by means of ether, or the anæsthetic stated on page 169, produce perfect anæsthesia. As soon as this is accomplished, cleanse the viscera thoroughly from all foreign matter by squeezing tepid water upon them from a sponge, and gently seizing, between the thumb and fingers, that portion of the viscus which had last protruded, compress it lightly so as to force back its contents, endeavoring to carry it into the cavity of the abdomen by pressing upon it with the forefingers. The peristaltic action of the digestive canal being entirely arrested during anæsthesia, the muscles of the abdomen perfectly relaxed, and the diaphragm partly quiescent from slow respiration, success will often crown these efforts.

When the protruded portion is returned, the sides of the wound should be closed by a few points of the twisted suture, and support given them by adhesive strips and a bandage.

II. **Intestines protruding, and irreducible.**—If it should be found impossible to accomplish the restoration of the protruding portion in this manner, owing to the constriction of the viscera by the sides of the wound, or the distention of the intestines by gas or from congestion of the omentum, it may become necessary to introduce a director, and enlarge the upper angle of the wound in the abdominal parietes by means of the probe-pointed bistoury, as shown in vol. ii.

When the protruded portion is omentum, the treatment will be very much the same as that advised for the intestines, unless strangulation has occurred, in which case it may become necessary to treat it as recommended in a similar condition in hernia, vol. ii. Guthrie thinks that allowing the omentum to remain partially unreduced, so that it may adhere to the cut edge of the peritoneum, diminishes the dangers of peritonitis and of ventral hernia.[*]

When the protruding intestine is greatly distended by gas, and thus increased in size, it has been recommended to make a number of small punctures in it to permit the escape of the flatus, when this appears to be the cause of its non-reduction. But such a proceeding is objectionable because, generally, compression of the intestine by the fingers near the orifice of the wound will force the flatus into the abdomen and thus empty or render flaccid the protruding portion, especially when the abdominal wound can be slightly enlarged, while the punctures will not always give exit to the flatus, owing to the prolapse of the mucous coat obstructing the openings. These punctures are also an additional cause of peritonitis. Cautiously enlarging the abdominal wound, it is repeated, is the better plan. When the intestine has protruded for some hours, and has become congested and is of a dark-red,

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* Commentaries, p. 498, Philadelphia edition.

or even black color, and is cold, it should yet be as promptly returned as possible, provided it is not gangrenous, as no artificial warmth or dressing can be as useful as the natural heat of the abdomen.   When the irreducible portion is congested omentum, the enlarging of the wound is often essential to its restoration; but if a *small* portion of omentum is firmly strangulated and the patient gives no evidence of constriction, as by vomiting, hiccough, etc., it may be simply covered with spread cerate and left to slough off; but if the protruding portion is as large as a walnut, and symptoms of strangulation are present, the wound in the abdomen should be promptly enlarged and the protrusion returned.   If the protruding omentum has, from long protrusion, become adherent and is disposed to gangrene, it is better to leave the case to nature than to attempt to hasten the sloughing process by ligating the protruding portion.   If the protruding intestine has been so constricted as to become gangrenous, it must be left to form an artificial anus, as in the cases of herniæ, described in vol. ii., such cases being, in the opinion of Macleod,* very liable to heal spontaneously.

## SECTION II.

### WOUNDS OF THE VISCERA.

Penetrating wounds of the abdomen, creating a wound of the abdominal contents, present injuries of a very varied and serious character, as the viscus involved and the extent of its injury depends on numerous circumstances; peritonitis is also much more frequently met with after these wounds than after the previous class.   In the treatment of peritonitis from these wounds, full doses of opium to arrest peristaltic action and quiet the circulation are especially useful, the patient being kept narcotized as far as is consistent with safety to life.   In this as in the other instances of peritonitis, the surgical treatment is identical with that employed in idiopathic peritonitis.

1. **Wounds of the Liver** are a very serious class of complications in abdominal penetrating wounds, yet not absolutely fatal, the issue being somewhat modified by the extent and depth to which this viscus is wounded. The first and main danger arises from internal hemorrhage.   According to Boyer, wounds of the convex portion of the liver give rise to dull, heavy pains in the shoulder; those of its concavity, to pain about the ensiform cartilage and epigastrium.   In either case the patient is sooner or later jaundiced, and there is apt to be vomiting, hiccough, and labored respiration.   The treatment, after checking the hemorrhage, if possible, by arterial sedatives, opiates, etc., is that of hepatitis from other causes, the wound in the liver being left to nature, and the abdominal wound closed.   Should a hepatic abscess supervene, it should be treated as directed in vol. ii.

2. **Wounds of the Spleen** are also a most serious class of wounds, especially from the free hemorrhage which they induce, they being in most points similar in prognosis and the general principles of treatment to wounds of the liver.

3. **Wounds of the Kidney and Ureters.**—The escape of bloody urine, with the cause and locality of the wound, will tend to assist the diagnosis; the prognosis of these wounds being almost invariably unfavorable, though not quite so much so as wounds of the spleen.   In all wounds of these organs the chief danger is from internal hemorrhage and peritonitis.

* Op. citat , p. 264.

## SECTION III.

### WOUNDS OF THE STOMACH.

**Wounds of the Stomach,** though of a very serious character, are not neces-
sarily fatal, especially when the liquid contents of the viscus do not escape
into the cavity of the peritoneum, of which a remarkable case is reported
by Archer, of Maryland, Medical Repository, 1812; and also in Eve's Re-
markable Cases, p. 280, Philadelphia edition, 1857. In Archer's case, a man
was cut by a stab with a knife, so as to open the abdomen nearly three inches
and the stomach more than two inches. The dinner recently eaten, and com-
posed of bacon, cabbage, and cider, was evacuated. As no surgeon was
near, an old soldier sewed up the wound with an awl and waxed thread, pass-
ing only through the integuments. On the ninth day the patient complained
of a lump in his right groin; this subsequently suppurated, and discharged
pieces of cabbage which had passed into the cavity of the abdomen from the
wounded stomach, inducing inflammation and suppuration. He recovered
entirely. The well-known cases of Beaumont and Ashby are quoted in
the Bibliographical Index at the end of this part.

**Symptoms.**—Besides the evidence furnished by the position and character
of the wound in the abdominal parietes, there is usually a severe pain in the
epigastric region; nausea, bloody vomiting, ardent thirst, with the evidence
of "shock," before described, followed, if there is hemorrhage from the gas-
tric vessels, by the usual symptoms of collapse and death.

**Diagnosis.**—The position of the wound and the escape of the contents of
the stomach render the diagnosis easy.

**Prognosis.**—Though exceedingly dangerous, extended wounds of the
stomach, as above stated, have sometimes recovered.

**Treatment.**—The treatment of wounds of the stomach consists—1. In
preventing, if possible, the escape of the contents of this viscus into the
peritoneum. 2. In promoting adhesion between the abdominal peritoneum
and that covering the stomach. 3. In subduing excessive inflammation.
4. In closing the gastric fistula that is apt to supervene.

The first and second indications may be accomplished by the use of some
of the sutures hereafter explained, vol. ii., in connection with wounds of the
intestines, then by combating the inflammation by leeches and the entire
antiphlogistic course, as little food being introduced into the stomach as
possible, while anodynes are freely used by the mouth and anus to develop
insensibility and diminish the suffering from thirst, nausea, and vomiting.
Gastric fistula will be hereafter alluded to in vol. ii.

## SECTION IV.

### WOUNDS OF THE INTESTINES.

All the intestines are liable to be wounded, in penetrating wounds of the
abdomen, but most frequently the small intestines, transverse colon, cæcum,
and sigmoid flexure are the portions injured, the duodenum and rectum being
more rarely touched. The higher the position of the intestine wounded, the
more serious, usually, is the injury, as, in addition to the risks of peritonitis,
we then have also those arising from defective nutrition. In studying the
effects of intestinal wounds, the arrangement of the fibres of the muscular

coat, and the loose attachment of the mucous coat of these viscera, with the tendency of their peritoneal covering to adhesive inflammation, should be borne in mind.    By the action of the longitudinal muscular fibres an intestinal wound, if transverse, will be made to gap, while longitudinal wounds will be acted on by the circular fibres.    Then, again, the contraction of the muscular coat favors the eversion of the loosely-attached mucous coat, and increases its tendency to plug up the orifice of the wound, thus preventing the escape of the intestinal contents, while the apposition of inflamed peritoneal surfaces favors adhesion, and the closure of the wound.    Provided, then, the peritoneal inflammation is limited, its presence is essential in saving the life of the patient, the danger being entirely due to the too great extension of the inflammatory action.

**Symptoms.**—When an intestine is wounded by a bullet or puncturing instrument, the signs of the injury are not always very evident.    Generally there will be either the symptoms of concealed hemorrhage, with passing of clotted blood by stool, vomiting, nausea, hiccough, etc., or there will be the escape of the intestinal contents through the wound, at least within a few hours after its creation, this being followed by the symptoms of peritonitis and paralysis of the muscular coat of the viscera, in consequence of which the abdomen is liable to marked distention and tympanitis.    The pulse usually indicates marked traumatic fever.    The elasticity of the abdominal parietes, and the resiliency and free movement of the intestinal convolutions will, however, sometimes enable the intestines to escape when the course and character of the wound would indicate the certainty of their injury, or if injured, will limit the injury to the surface first touched.    Thus bullets have been known to perforate the anterior walls of the intestine, and be voided by stool without the opposite intestinal surface being injured, while in other instances the intestines have been fairly struck without being perforated.

**Diagnosis.** — Wounds of the intestine that can be seen are, of course, easily recognizable ; but except in the instances of protrusion, this is rarely possible.

**Prognosis.**—Wounds of the intestines are always of a very serious character, those which are transverse being more dangerous than those which are parallel to the axis of the canal.    In any case recovery is possible, though the prognosis should be guarded.

**Treatment.**—The indications for the treatment of intestinal wounds are, first, to prevent the effusion of blood, etc. into the sac of the peritoneum ; second, to induce adhesion of the edges of the wound and its perfect closure. In small punctured wounds accessible from the abdomen, as in cases of intestinal protrusion, these indications are best fulfilled by the means suggested long since by Travers, viz., to pick up the wounded portion in the forceps and ligate it firmly by a fine thread.    Inflammation being thus developed in the peritoneal coat around the ligature, fibrin is effused over it so that it becomes imbedded, while the adjacent peritoneal surfaces are glued together.    Then, as ulceration perforates the internal coats that are constricted by the ligature, the latter will at last reach the cavity of the intestine, and the loop of the ligature will be discharged per anum, the surface ligated or inclosed in the thread being also discharged as a slough, the fibrinous adhesions formed in a few hours after the application of the ligature preventing the escape of the intestinal contents into the peritoneal sac. When the intestinal wound is more extensive, whether transverse or longitudinal, it should be closed by an appropriate suture, many of which are described in vol. ii.    After the closure of an intestinal wound, opiates should be freely given "to place the intestine in splints ;" the patient being prevented from having a stool until union may be anticipated, say five or seven

days.  The treatment appropriate to general peritonitis, as the entire anti-phlogistic course, with warm cloths, etc., should also be carefully and judiciously observed.

The fistula and artificial anus that sometimes are left after intestinal wounds, are to be treated as hereafter directed in those resulting from hernia.  When foreign bodies remain imbedded in the intestinal canal, they may demand the treatment described under the head of Enterotomy, vol. ii.

## SECTION V.

### WOUNDS OF THE GENITO-URINARY.

**Wounds of the Urethra and Perineum.**—Blows, falls, and sometimes gunshot wounds, occasionally create such an injury of the perineum as either opens the urethra directly, or induces sloughing, and thus destroys the coverings of the urethra.   In all these injuries it is of great consequence to prevent the urine escaping into the loose areolar tissue of the perineum and scrotum, or when it has done so, to evacuate it promptly in order to prevent the development of gangrene, and the sloughing of the integuments, with the constitutional disturbance usually attendant on gangrene.   As soon, then, as the urethra is wounded a catheter should be carefully introduced into the bladder and retained there, with appropriate change of the instrument, until the wound has healed, while, if the perineum has become infiltrated with urine, numerous punctures through the skin and perineal fascia should be promptly made with a lancet or sharp-pointed bistoury, and the exit of the effusion aided by pressure.   If the urine is permitted to remain twenty-four hours in the areolar tissue, bound down by the perineal fascia, sloughing of the integuments may be anticipated.   When sloughing of the integuments is present it should be treated locally and constitutionally in the manner directed for Gangrene, page 276.   Should a perineal fistula result from the wound, it should be treated as before directed, page 312.

## SECTION VI.

### WOUNDS OF THE BLADDER.

**Wounds of the Bladder** are dangerous from the risk of general peritonitis, especially when the wound is in that portion of the viscus that is covered by the peritoneum.   Yet extensive wounds of the bladder have been reported in which the patients have recovered.   In all the wounds of the bladder the patient is exposed to the risks of pelvic infiltration by the extravasated urine, as well as to cystitis from the wound in the coats of the bladder. The great indication in the treatment is to prevent the effusion of urine into the adjacent parts, which may be accomplished by keeping a catheter without any plug (Fig. 200) constantly fastened in the bladder, frequently washing it out if it become clogged with clots of blood, by carefully injecting water through it with a syringe.

Musket-balls and other foreign substances, if left in the bladder, may become the nucleus of a calculus, and require to be removed ultimately by lithotomy.

Wounds of the pelvis, as by musket-balls, may also involve the bladder, cause hemorrhage from injury to the main blood-vessels, and be followed subsequently by necrosed bone and long-continued suppuration.   Some-

times these wounds will present singular complications, as in the case of
Captain K., 14th Indiana Regiment, whom I saw, wounded at Winchester.
In this case the ball passed through the dorsum of the left ilium, perforated

Fig. 200.
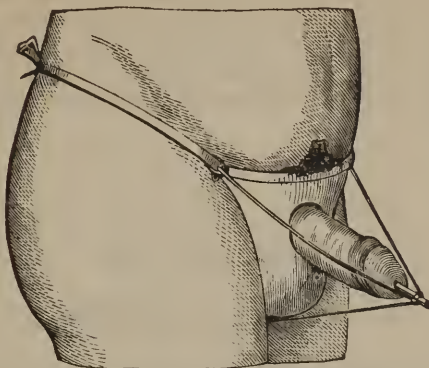


A REPRESENTATION OF A SIMPLE METHOD OF RETAINING A CATHETER IN THE BLADDER IN THE TREATMENT OF
WOUNDS OF THIS VISCUS, OR IN CASES OF STRICTURE OF THE URETHRA.—A square piece of muslin, with a tape
to each corner, and a hole for the penis, is to be applied and fastened around the pubes, the two tapes from
the perineum being tied to those which go over the groins.   Then the four ends of two ligatures tied
around the catheter are to be tied as shown in the figure.

the intestinal canal, so that flatus and feces escaped through the iliac wound,
and lodged on the rim of the pubis near the right spermatic cord.    In
attempting its extraction, it slipped, as my knife touched it, into the pelvic
cavity.

## SECTION VII.

### WOUNDS OF THE PENIS AND TESTICLES.

**Wounds of the Penis and Testicles** are sometimes seen as the result of
warfare, though they are most common in lunatic asylums and penitentiaries.
They mainly demand the prompt arrest of hemorrhage when this ensues,
(many of these being lacerated wounds and not bleeding,) and the subsequent
prevention of the passage of the urine over the wound.    The penis has, in
some instances, been cut off, or partially divided, intentionally, for the grati-
fication of revenge.    In these cases the chief blood-vessels should be tied,
and then a catheter kept in the urethra to expedite the healing of the stump.

Wounds of the penis sometimes heal readily, as in the case of a private
of the 110th Regiment Pennsylvania Volunteers, wounded at Winchester,
under General Shields.    In this case the Minié ball entered at the left
inguinal ring, passed behind the cord, divided the left crus penis, traversed
the perineum, and came out beneath the right gluteus magnus muscle—the
wound healing without a bad symptom, under rest and simple water-dress-
ings.

Wounds of the **female** generative apparatus may occur, very extensive
lacerations of these parts having been produced by the patient falling astride
of a rocking-chair or the stopper of a bath tub, or, as I have seen, from
being gored by a pet deer.    In such cases, the chief danger is, usually, from
the inflammation and perineal suppuration which will ensue, and this should
be combated upon general principles.

Wounds of the **Buttock** and **Perineum** are also sometimes created by falls, or, as once occurred, by the breaking of a chamber-pot under the weight of a heavy man.   Under these circumstances the wound, in addition to the general treatment of all lacerated or incised wounds, should be carefully examined, and any hemorrhage present promptly checked, in order to guard against infiltration of the tissues, especially in the buttock.   They should then be freed from all particles of foreign matter, and covered by the tepid water-dressing, as directed in lacerated wounds, the burrowing of pus being carefully guarded against.   The best means of retaining a dressing to the buttock is by means of the handkerchief bandage of Mayor, as shown in Fig. 110, page 158.

# CHAPTER XII.

## WOUNDS OF THE EXTREMITIES.

THE extremities, on account of their exposed position, are liable to severe injuries, both in civil and military life.   Yet, unless death results at once from violent hemorrhage, there are few disorders in which science can do more for their relief.   The danger of **Wounds of the Extremities** as a class depends in a great measure upon the injury that is sustained by the bones and joints; by the blood-vessels and nerves, as well as upon the extremity affected.   The amount of injury to the main blood-vessels and nerves is especially important in reference to the result.   The diagnosis, prognosis, and treatment of wounds in each member present many points of interest and importance which require special consideration.   The treatment, especially in cases creating compound fractures, will be given hereafter in connection with fractures.   That alluded to in this portion of the work is merely in reference to gunshot wounds, and based on a careful digest of the opinion of the latest military authorities, as settled in recent battles.

## SECTION I.

### WOUNDS OF THE HAND.

Severe contusions of the hand are quite common, and are to be treated upon the general principles already detailed in connection with contused wounds.   The most frequent seat of these wounds is upon the back of the fingers and near their extremities, this being frequently followed by necrosis of the phalanges.

When an incised, lacerated, or gunshot wound of the fingers, even of a simple character, exists, it may become serious because the joints are superficial and liable to be opened.   Wounds of the hand are primarily dangerous on account of hemorrhage, the arteries in the palm being numerous, and freely communicating with each other.   The tissues of the palm and fingers are also very dense, so that in deep-seated wounds the pain of either is apt to be intense, and the pus, if formed, is liable to travel under the palmar fascia, and extend up among the muscles of the forearm by following the course of the tendons, while tetanus will frequently supervene, especially after punctured wounds of this region

**Prognosis.**—The prognosis of wounds of the hand will depend chiefly on the nature and depth of the injury.

**Treatment.**—The treatment of wounds of the hand depends entirely on their character and extent. If the phalangeal or metacarpo-phalangeal articulations are laid open without injury to the bones, the wound should be accurately closed by sutures, or by adhesive plaster, and the parts kept at absolute rest. By these means, especially if assisted by the local application of the cold water-dressing, union by the first intention may be obtained even in extended lacerations, and the patient retain the motion of the joint. Frequently, however, suppuration takes place, and then care must be taken to prevent the confinement of the pus, by making free incisions in the direction of the tendons, avoiding their injury; after which the finger should be placed and retained in a flexed position, especially if there is a probability that anchylosis may result. If the wrist-joint or the joints of the carpus be wounded, the ensuing inflammation is liable to be severe, and the constitutional disturbance marked. Suppuration will almost certainly take place, and some stiffness of the joint result; still, under the influence of rest, the application of the cold water-dressing, and a simple and unirritating regimen, a favorable termination may be looked for as to the usefulness of the limb.

When hemorrhage follows a wound of a finger, it may be easily arrested by ligature applied to the digital arteries on either side of the phalanx, or by pressure on the sides of the finger. Wounds of the arteries in the palm of the hand cause much more trouble. In some cases it is difficult to apply a ligature to the wounded vessel without wounding the tendons, yet compression only offers an uncertain substitute, owing to the want of a firm basis of support due to the shape of the metacarpal bones. In these cases the arteries should be tied, if possible, at their bleeding orifices, or a ligature be applied to the radial at the wrist, or the radial and ulnar may be both tied at the same time. The anastomoses of these vessels with the interosseous and with the articular branches is, however, so free that the ligature of the main arteries will sometimes not suffice, and then the wounded vessel must also be tied in the wound. In numerous instances compression of the palmar vessels, by packing the wound with charpie and binding the hand to a palmar splint, has sufficed to check the hemorrhage without necessitating the ligature of the main artery.

If suppuration occurs in the sheaths of the tendon, in the fingers, or beneath the palmar fascia, the pain experienced by the patient will be very severe. Relief will, however, be promptly given by a deep, longitudinal incision, so made as to avoid injury to the main blood-vessels. If the flexor tendons should slough, or be divided by the original wound, the finger or fingers must be kept semiflexed so as to encourage adhesions in that position, though deformity will sometimes ensue from the overaction of the opposing muscles.

It has been frequently said that tetanus is more common after wounds of the hand and foot than elsewhere; but this may fairly be doubted, or at least its apparent truth explained by the fact that these parts are more exposed than others to punctured wounds. In speaking of gunshot injuries of the hand, Stromeyer says, "I have never seen tetanus arise in these injuries."*

The bones of the fingers are frequently broken by blows, circular saws, and various parts of machinery, musket and cannon balls, and pieces of shell, at the same time that an external wound is received. In such cases amputa-

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* Fractures of Bones occurring in Gunshot Injuries, by Louis Stromeyer. Translated by J. F. Statham. London, 1860, p 27.

tion has usually been performed, and, when necessary, should be done as early as practicable. The success is generally complete. In connection with this, Stromeyer says that "all exarticulations of the fingers, which were performed after an interval of forty-eight hours, were followed by very violent inflammation, obstinate suppuration, and not unfrequently by stiffness of many of the fingers or of the whole hand. * * If the operation cannot be performed before inflammation has set in, the full development of suppuration must be waited for."* An amputation may be performed at the joint, or through a phalanx, the former being preferable as tending to the formation of a better stump, and preventing exfoliation of bone. Instead, however, of amputating indiscriminately in finger wounds, resection will prove of advantage in cases where the severity of the injury is limited, as those received from a circular saw, etc. "Professor B. Langenbeck," as quoted by Guthrie,† "has operated in some instances successfully, and without the loss of the finger, by sawing off, in his first case, the articulating ends of the first phalanx and of the metacarpal bone of the forefinger, in consequence of an injury from a rotating piece of machinery; in another, the ends of the first and second phalanges of the middle finger were resected after a severe laceration; and in a third case, he sawed off the end of the second phalanx, and, removing the whole of the bone of the third of the forefinger from the soft parts, lifting the nail, the man recovering with a shortened but useful finger. In all these cases, the flexor and extensor tendons were from the first uninjured." In these resections as much as possible of the periosteum should be preserved. It is difficult, in the adult at least, to save much of it; yet a careful scraping of the part to be removed will perhaps secure enough.

If a compound fracture of the metacarpal bones has taken place, all surgeons agree that as much of the hand should be preserved as possible, as even a thumb or finger will prove of great value to the sufferer. Partial amputations of various kinds performed on the hand have resulted very favorably. But unless the part has been very much shattered it need not be removed. Macleod states that "the talent of preserving the hand and foot in these injuries was well shown in the Crimean hospitals, and, in general, the results rewarded the endeavors made to save the member." "It is remarkable how few sequestra separate in gunshot wounds of the hand, even when the shattering of the bones has been great. The extrusion of any large piece of bone seldom occurred, so far as I saw;"‡ and Stromeyer says, "I have met with a case where a bullet had transversely traversed and broken the metacarpal bones of the four fingers, where nevertheless the hand was preserved, and in a completely useful condition. The healing occurs with some shortening of the metacarpal bones, the slight discharge of sequestra being very striking; all operative interference should be unthought of."§ If any amputation is considered necessary, it should be performed through the metacarpals rather than at their articulations with the carpus, as the ensuing inflammation will be less severe. If the hand be saved, the motion of the fingers will be apt to be impeded on account of adhesions of the tendons taking place. Care should therefore be taken to keep the hand or fingers flexed.

* Stromeyer. op. citat., p. 27.

† Commentaries on the Surgery of War, by G. F. Guthrie, F.R.S. Sixth edition. Philadelphia, 1862. p. 140.
   See also two cases collected by Dr. Hodges. The Excision of Joints by Richard M. Hodges, M D , (Boylston Prize Essay.) Boston, 1861. p. 87.

‡ Notes on the Surgery of the War in the Crimea, by George H. B. Macleod, M.D., F.R.C.S. Philadelphia, 1862, p. 273.

§ Stromeyer, op. citat., p. 27.

Stromeyer mentions a case in which no interference with the motion of the hand resulted, after a bullet passed through the *second row of the carpus*. Yet these cases will prove very serious unless promptly treated, by means similar to those to be recommended for compound fractures involving the wrist-joint.

## SECTION II.

### WOUNDS OF THE WRIST-JOINT.

The wrist-joint may be opened, without injury to the bones, by sharp-cutting instruments. In these cases the limb may usually be saved, though the inflammation is apt to be severe. An attempt, however, should be made to obtain union by the first intention, by careful employment of the cold water-dressing; but if this does not completely succeed, the wound had better be freely laid open, or even enlarged, so as to prevent any accumulation of pus. The treatment should be strictly antiphlogistic, both generally and locally. The continued application of ice in bladders will do much to lessen the severity of the inflammation. If recovery take place, more or less of the mobility of the joint will usually be lost. When wounds of this joint are promptly closed, and then reaction prevented by the use of the cold water-dressing, most happy results will be sometimes obtained.

### § 1.—Compound Fractures involving the Wrist-Joint.

In these cases the joint may be opened at the same time that the ends of the radius and ulna have been broken, or the first row of the carpus may be shattered; or, it may be that both the carpus and bones of the forearm are injured. The inflammation ensuing on these injuries will, therefore, be of a very severe character, and the constitutional disturbance necessarily marked. Stromeyer thinks that such injuries, especially when connected with gunshot wounds, are peculiarly disposed to cause death from pyemia.[*]

In these cases it has been deemed best to perform amputation, and the result has been, even in the military service of the Crimea, a ratio of mortality of only 1·8 per cent.[†] When demanded, amputation at this point may be performed through the bones of the forearm, or at the wrist, according to the condition of the radius and ulna, and of the surrounding tissues necessary to form a flap. The disarticulation at the wrist should be preferred where practicable, as the member would be more serviceable in after-life, and the operation itself is not objectionable. (See vol. ii.) Excision of the wrist has been proposed for these injuries in place of amputation. It was performed three times in the Crimea, with one fatal result. This operation has also been performed elsewhere for compound fractures in a few instances, and quite often for disease. Hodges, after examining the cases reported, concludes, that "it would seem that excision of the lower end of the radius is an operation well suited to traumatic cases, especially when it is remembered that the hand, preserved in the most imperfect condition, is so great a gain over its entire loss."[‡] Yet, when performed for a diseased condition, he says: "In the present state of our knowledge excisions of the wrist-joint, whether partial or complete, being followed by a large proportion of failures, requiring

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[*] Stromeyer, op. citat., p. 26.          [†] Macleod, op. citat., p. 328.
[‡] Hodges, op. citat., p. 76.

a very long treatment, and, when successful, the usefulness of the hand being so limited, are operations not sanctioned by sound judgment or conservative surgery."*    The necessity, however, of either amputation or excision in compound fractures involving the wrist, has been questioned by Stromeyer, who thinks that by means of a strict antiphlogistic treatment, and by free incisions, the limb may be saved.    He says : "I am yet by no means of the opinion that gunshot wounds of the wrist necessitate amputation, unless extensive laceration is present, which of itself demands the measure."    And again : "I am satisfied that by vigorous abstraction of blood, by the application of ice, and by opium, the dangerous advances of the inflammation can be arrested, and amputation be obviated."†

In the lacerations of machinery seen in civil life, the results of irrigation in these wounds have, in my hands, been most satisfactory in numerous instances; marked examples of similar results have also been published by Mr. Gilchrist, of Aberdeen.‡    In one of these a man, injured by the machinery of a paper-mill, had the wrist-joint opened, the hand half separated from the forearm, the tendons torn, and the inferior articulating end of the radius exposed.    Under irrigation no inflammation took place, there was no suppuration, and an "excellent cicatrix was obtained in little more than a fortnight."

## SECTION III.

### WOUNDS OF THE FOREARM.

The forearm is liable to many and severe injuries; yet the result, under careful management, is generally favorable to life and to the usefulness of the member.    If any of the large arteries be wounded, the rules of Guthrie are to be strictly followed, and "no operation performed unless the artery bleeds.    If it is bleeding, tie it at the part wounded — a ligature being applied at the distal as well as at the proximal extremity."    If the ligature on the proximal extremity must be placed above an anastomosing branch, that branch must also be tied.    For instance, if the ulnar is wounded so high up as to require a ligature upon the brachial, not only must the distal extremity of the ulnar also be tied, but the radial in addition.    If this is not done, the blood soon flows back along the radial to the gaping wound, and secondary hemorrhage results.    These principles apply to wounds of the arteries in all parts of the body.    They have been proved to be of immense advantage by Guthrie, and lately by the surgeons of the Crimean war, in saving life by controlling and preventing secondary hemorrhage.

### § 1.—Compound Fractures of the Forearm.

In **Compound Fractures of the Forearm**, the limb may be saved in almost every instance, unless the soft parts are very extensively lacerated.    If amputation is even then demanded, the danger to life is but slight.    In attempting to save the limb, the primary sequestra—those already separated by the injury—should be carefully removed ; the secondary sequestra—those remaining partly attached after the injury—are to be taken away only after being loosened by suppuration ; and the tertiary—those becoming necrosed from the intensity of the inflammation—will probably be small and but few

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* Hodges, op. citat., p. 96.            † Stromeyer, op citat., p. 26.
‡ British and Foreign Med. Review, July, 1846.

in number. The forearm should be kept perfectly at rest, and primary applications of cold water, with, subsequently, or when suppuration is free, the warm water-dressing, should be employed. This treatment, with the results recorded, is certainly preferable to operative interference; yet resection of the ends of the bones has had its advocates. Stromeyer condemns it, and alleges that it causes non-union.

## SECTION IV.

### WOUNDS OF THE ELBOW-JOINT.

**Wounds of the Elbow-Joint,** without injury to any of the bones, may occur from cutting instruments, or from blunt fragments, if driven with great velocity, as pieces of shell. Or the joint may be opened secondarily from the extension of inflammation from a distant point. In these cases the usual severe symptoms of inflammation ensue, but under antiphlogistic measures, even in military service, the limb may be preserved without any operation. Under the most favorable circumstances, however, considerable anchylosis may be expected, though Macleod relates a case of a dragoon, in which the elbow-joint was opened by a sword-cut and the olecranon completely detached, yet who readily recovered, with enough motion to constitute a very useful arm. During the treatment, which should be similar in principle to that recommended in wounds of the wrist-joint, the limb should be kept in a flexed position, so that if anchylosis should occur, the usefulness of the arm may be interfered with as little as possible.

### § 1.—Compound Fractures involving the Elbow-Joint.

**Compound Fractures involving the Elbow-Joint** are very serious injuries. "If treated, even under active antiphlogistic remedies, serous infiltration of the surrounding soft parts quickly follows the reception of the injury; violent fever soon sets in; the pain in the joint becomes excessive, and the slightest touch or motion cannot be borne. The swelling increases as suppuration takes place, and though the external opening may be quite free, the pus is apt to travel between the muscles and beneath the skin both of the arm and forearm, and to discharge itself by various sinuses. The cartilages separate from the bones; the bones themselves become inflamed, and death frequently results from pyemia. In the most favorable cases, indeed, the patient may recover without an operation, but commonly only after long suffering, after many incisions have been made, and the necrosed pieces of bone have been removed by degrees. In these cases a perfect anchylosis of the joint cannot be avoided."* Out of thirty injuries to the elbow, Macleod reports that six recovered without any operation, with more or less stiffness or partial anchylosis of the joint. In these, however, there had been but little injury to the bone. He says elsewhere: "I have seen several cases in which, after being traversed by a ball, attempts have been made to save the elbow without excising it, but such trials were anything but encouraging. The motion of the joint and its consequent use will be found much greater after resection than when the arm has been saved without such an operation."† If an attempt be made to save the limb during the height of the

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* Esmarch on Resection in Gunshot Injuries, p. 77.
† Macleod, op. cit., p. 293.

inflammation, a strict antiphlogistic course must be pursued, and anodynes freely given to lull the intense pain. Ice should be applied, and free incisions made as soon as the pus distends the joint or approaches the surface. These openings should be made as much as possible in the depending portions of the limb, so that the accumulation of pus may be prevented. The limb should also be kept perfectly at rest, and in a flexed position. The common flat angular splint does not answer well for this purpose, as it allows more or less motion, and it is better therefore to use a carved wooden or tin splint, or one made of pasteboard, wire, papier-maché, gutta-percha, or plaster of Paris moulded accurately to the limb.

When the bones composing the joint have been much injured some operation will be necessary, and it was formerly the custom to perform amputation in such cases at the elbow, or through the arm above the joint. Even now amputation is sometimes considered necessary, and especially when the fracture extends high up the humerus, and the surrounding tissues are extensively injured, or when there is also a wound of the brachial artery; but except under such conditions, resection of the elbow-joint has, with most surgeons, been growing in favor, and has almost superseded amputation. Esmarch states that, during the Schleswig-Holstein campaigns, amputation for simple shattering of the elbow-joint by bullets, without other complications, became more and more rare; 6 amputations of the arm were performed in 1848, 3 in 1849, and none in 1850, resections of the joint being preferred.* He also reports that in 54 cases of amputation 19 died, whereas in 40 cases of excision only 6 died. If these cases are added to those occurring in the Crimean war, the ratio of mortality in cases of excisions in military practice seems to be about 18·33 per cent., that of amputation of the arm 23·07 per cent. The percentage is therefore 4·74 in favor of excision. The ratio of mortality in cases of amputation through the elbow-joint is much greater than either.† In civil practice, when excision has been performed in traumatic cases, the result has been still more favorable; in 21 cases collected and reported by Hodges, there was but one death. Resection of the elbow, then, may be considered as safer to life than amputation. It also preserves a limb of more or less usefulness. After the operation there is a great tendency to anchylosis, and when this appears to be taking place, the arm should be carefully kept flexed. In the Schleswig-Holstein war it was found that the best position was that forming an obtuse angle of about 130 to 140 degrees. If it was less than this, the patient frequently complained of excessive pain. It is better, however, to retain some motion at the joint, to accomplish which passive motion must be made early, and frequently repeated. It is also said to be advisable, in performing the operation, to preserve as much of the periosteum as possible, so as to prevent shortening of the limb, by a regeneration of the bone. In the few cases in which I have performed resection of the elbow-joint much satisfaction has been obtained, the limb subsequently being useful.

## SECTION V.

### WOUNDS OF THE ARM.

**Wounds of the Arm**, from machinery and gunshot wounds, often are attended with very extensive laceration of the soft parts without any injury to the bone. Even in apparently desperate cases of this kind recovery may take place. Guthrie says "that the bone being uninjured, no flesh wound,

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* Esmarch, op. cit., p. 79.            † Hodges, op. cit., p. 51.

made either by a cannon or musket shot, even including a division of the artery, absolutely demands amputation."* Hemorrhage must be controlled in accordance with the principles already given, and the wound treated as usual.

### § 1 —Compound Fractures of the Humerus.

**Compound Fracture of the Humerus,** as the result of wounds, may occur in any portion of the shaft. The fracture may extend longitudinally along the bone for a considerable distance, but the fissure will not often enter the joints, as it seldom passes through an epiphysis.† This longitudinal splintering of the bone is more apt to result after gunshot injuries than perhaps any other variety. It is also more commonly made by the conical than by the spherical ball, and is therefore met with more frequently in the recent wars than formerly. Three cases of this fracture from Minié balls were among fifty wounded Pennsylvanians that I brought to Philadelphia after the battle at Winchester, Virginia, all of which, thirty days subsequently, were doing well. It is of itself a serious complication, the splinters causing extended and severe inflammation.

In compound fractures of the humerus, if the soft tissues are extensively injured, or merely penetrated, or if the brachial artery be wounded, amputation may be sometimes, but not invariably, resorted to, that life may be saved. In cases seen in the field, with the necessity of moving hospitals, amputation will be more imperative than in settled hospitals. When the injury is high up, it is preferable to amputate through the humerus, if possible, rather than at the shoulder-joint, as the resulting deformity to the shoulder will be far less, though a very small portion of the humerus can be saved. Yet when the artery is not wounded, the injury must be indeed extensive to justify amputation, as the arm will frequently recover and be useful after the most dreadful accidents. There is the still further encouragement to attempt to save the limb, to be gained from the fact that if the attempt fail, secondary amputation may be resorted to, and the result prove very favorable.‡ This attempt to save the limb grew in greater favor in each succeeding campaign in the Schleswig-Holstein war. At first, under the direction of Langenbeck, the course of Baudens was followed, the attempt at preservation being made by resection of the fractured ends. The result was considered favorable.§ Afterward, however, Stromeyer did not perform primary resection, but merely removed the loosened splinters. The result is reported to have been even more favorable than the treatment by resection.‖ In the Crimean war Macleod reports that the resections in the continuity of the bones of the upper extremity did remarkably well.¶ Yet owing to the fissures extending into the shaft of the bone, if resection is performed, very considerable portions of the bone must be removed, and non-union or false joint is apt to result. When the attempt is made to save the limb without resection, there is no doubt of the propriety of removing the primary splinters, but there is a difference of opinion among surgeons of the present day, upon the question of removing the secondary splinters. The greater number of authorities are in favor of removing them at once. Stromeyer, however, insists that they should be allowed to remain, their sharp ends being merely sawn off.** In the after-treatment of these cases absolute rest of the limb is of the utmost importance, and the use of a splint judiciously arranged to permit

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* Guthrie, op. cit., p. 134.
† Stromeyer, op. cit., p. 22.
‡ Macleod, op. cit., p. 271.
§ Esmarch, op. cit., p. 54.

‖ Esmarch, op. cit., p. 55.
¶ Macleod, op. cit., p. 263.
** Stromeyer, op. cit., pp. 7, 23.

the dressing of the wound, without allowing motion in the fracture. In all cases the liability of these fractures to result in false joint should be borne in mind, and perfect rest of the fragments insured. In the Schleswig-Holstein war this was thought to be best obtained by confining the arm to the thorax, in addition to the use of splints.

## SECTION VI.

### WOUNDS OF THE SHOULDER-JOINT.

**Simple Wounds of the Shoulder-Joint,** when there has been no injury to the bones, are followed by severe inflammation, which is apt to cause more or less stiffness. The limb can usually be saved, and the wound will frequently heal quite readily.

#### § 1.—Compound Fractures of the Shoulder-Joint.

**Compound Fractures involving the Shoulder-Joint** do not necessarily demand an operation, even when the head of the humerus has been comminuted. If the wound be enlarged, all loose pieces of bones removed, the antiphlogistic treatment strictly carried out, and free incisions made to prevent any confinement of pus, the limb may be saved. This can, however, only take place after long and profuse suppuration, and after the limb has become firmly anchylosed * But as this process is dangerous in many instances to life, and even, at best, impairs a great deal of the usefulness of the limb because of the anchylosis, the operation of excision has been proposed, and the result of the operation has been very favorable, the ratio of mortality being less than that of amputation at the shoulder-joint. Hodges has collected, from various sources, "96 cases with 25 deaths, or a mortality of 26 per cent."† Of these, the primary operations exhibit a mortality of 30·18 per cent., while the secondary show only 17·64 per cent. The cure generally takes place rapidly ; some mobility will nearly always remain, and in many the motion and command over the arm is so great that the patients can perform heavy work. The portion that has been removed successfully in some cases has been as much as four or five inches in length.‡ If the scapula has also been fractured, the operation of resection is by no means so successful, but by removing the loose splinters and sawing off the sharp spiculæ, the result has sometimes been favorable.

Amputation at the shoulder-joint is, however, necessary when the axillary artery and nerves have been wounded, or the surrounding tissues have been very extensively injured.

## SECTION VII.

### WOUNDS OF THE FOOT.

**Wounds of the Foot** present a very similar class of injuries to those occurring in the hand, and are to be treated in accordance with the general

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* Guthrie, op. cit , p. 120; Macleod, op. cit., p. 291; Stromeyer, op. cit., p. 21; Esmarch, op. cit., p. 64.

† Hodges, op. cit., p. 29.                    ‡ Esmarch, op. cit., p. 65.

principles there stated.    The hemorrhage is, however, often more diffi-
cult to control, as, in addition to the free anastomosis of the arteries, the
plantar arch lies so deep as to present many obstacles to the application of
the ligature.    Still the rule should be faithfully observed to tie the artery
at the seat of injury, and at the distal as well as the proximal extremity.

If the joints of the toes are opened by incised wounds a cure will usually
result.    During the treatment the toes should be kept, not in a flexed posi-
tion as in the fingers, but extended.    If stiffness of these joints ensues, it is
a matter of minor importance, as it does not interfere with walking.    If
the bones are fractured at the same time that an external wound is received,
amputation is usually performed.    Stromeyer, however, states that it is not
often necessary, as recovery readily takes place without its employment.*
But when the contusion is severe, it is perhaps better to amputate rather
than wait for continued suppuration and the separation of necrosed portions
of bone.    A toe saved under such circumstances is often the subject of great
annoyance, as the scar is frequently tightly adherent to the bone, and cannot
bear the pressure of the boot.    The results of amputation of the toes are
exceedingly favorable if the operation is performed quickly after the recep-
tion of the injury, or when suppuration has fairly commenced.    The loss of
a toe, or even of several of them, is a source of but slight inconvenience.
It is a good rule, however, in military service, not to amputate the toes, and
indeed the fingers also, primarily but secondarily.    After a battle the surgeons'
time is so completely occupied by the severe injuries that these minor opera-
tions cannot generally be performed before inflammation has begun.    It is
then better to wait till suppuration has fairly taken place.†

The experience of the Schleswig-Holstein and Crimean wars proves
that compound fractures of the metatarsus, and also of the tarsus, will
usually do well without any operative interference beyond the removal of
loose fragments of bones, unless there has been very extensive injury of the
surrounding tissues.    Even when the comminuted fracture of bone has been
severe there is but slight exfoliation.    If amputation is necessary on account
of the injury to the soft parts, it is advisable to save as much of the foot as
possible.    We must then resort to Lisfranc's, Chopart's, or Pirogoff's opera-
tions,‡ according to the locality of the injury.    Resections have also been
performed in these cases, but experience seems to have condemned them.
In a few exceptional cases it may be admissible to remove all the tarsus
except the astragalus and os calcis, as was done by H. J. Bigelow, of Bos-
ton, by means of two incisions, corresponding to those in Chopart and Lis-
franc's amputations.§

# SECTION VIII.

## WOUNDS OF THE ANKLE-JOINT.

**Wounds of the Ankle-Joint,** even when the bones are uninjured, are gen-
erally followed by severe constitutional and local symptoms.    If complica-
tions do not exist, it will be proper, however, to make an attempt to save
the limb.    Macleod reports that in the Crimean war these wounds generally
did well when the limb was kept perfectly immovable and the wound enlarged,
so as to allow free exit to the discharges.‖

* Stromeyer, op. cit., p. 32.         § Hodges, op. cit., p. 188.
† Ibid., p. 27.                       ‖ Macleod, op. cit., p. 290.
‡ See vol. ii.

### § 1.—Compound Fractures of the Ankle-Joint.

**Compound Fractures involving the Ankle-Joint** generally necessitate amputation. When, however, it is merely one of the malleoli that is injured by a grazing shot or blow, recovery may take place, and the anchylosis resulting may not be complete.* Excision of the ankle-joint does not seem to have met with much favor, or else cases to which it would seem to be applicable seldom occur. It has not often been performed in compound fractures, but in compound dislocations its success has been great. In twenty-nine cases reported by Jaeger, there was only one death.†

## SECTION IX.

### WOUNDS OF THE LEG.

**Wounds of the Leg** are to be treated in accordance with the usual rules. The hemorrhage, if the wound is deep, and in the upper part of the leg, is difficult to control, as the arteries lie so far from the surface. With care, however, the ligatures may be applied at the wounded part. The suppuration is generally profuse, and the pus is apt to be confined by the thick aponeurosis. If the external wound is small, this should be guarded against by free incisions.

### § 1.—Compound Fractures of the Leg.

**Compound Fractures of the Bones of the Leg.**—If the fibula alone is broken, even in severe injuries, the result is almost always favorable. If the tibia alone is injured, and the splintering does not extend very far, the limb may often be preserved, as the fibula will act as a splint and prevent much movement of the fragments. If both bones are broken, the comminution is frequently so severe as to call for amputation. In some cases, however, the limb may be saved, and this should be attempted by carefully removing the fragments rather than by resection of the broken ends. This latter operation has proved to be seldom successful, and more tedious than the simple removal of fragments. The arteries also lie so closely in contact with the bones as to be liable to injury during the performance of the operation.

## SECTION X.

### WOUNDS OF THE KNEE-JOINT.

**Wounds of the Knee-Joint.**—On account of the great extent of the capsule of the knee, there is a greater frequency and more imminent danger in these wounds than in the case of other joints. On account of the violent inflammation and suppuration that ensue, amputation is generally necessary, sooner or later, even when none of the bones have been injured. In some cases, however, after a strict antiphlogistic treatment has been pursued, recovery has resulted with more or less anchylosis. If an attempt be made to save the limb, great care should be taken to prevent the accumulation of

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* Stromeyer, op. cit., p. 31.          † Hodges, op. cit., p. 174.

pus.  It would seem to be a safer practice to enlarge than to attempt to hasten the closure of the wound after inflammation has fairly begun in the joint.  The limb should be kept extended.

### § 1.—Compound Fractures of the Knee-Joint.

**Compound Fractures involving the Knee-Joint** are almost necessarily fatal, unless amputation of the thigh be performed.  Esmarch says : "All gunshot injuries of the knee-joint, in which the epiphysis of the femur or tibia has been affected, demand immediate amputation of the thigh.  It is a rule of deplorable necessity, already given by the best authorities, and which our experience fully confirms.  In vain have we often made the attempt to leave the case to nature, to save an unhappy man the loss of his limb, on account of a slight injury, but just so often have we had cause to repent that amputation had not been performed in the first instance."*  The experience of the Crimean war fully corroborates this.  Macleod reports, however, some cases, in which the knee-joint was opened and the bone injured by fragments of shell, as having done well.  The patients recovered with some anchylosis.†

These cases, when left without operation, generally pursue the following course : A week or more, especially under antiphlogistic treatment, may elapse before any symptoms of violent inflammation arise.  Sometimes, however, severe symptoms begin very soon, and increase with great rapidity. The abscesses which so frequently follow almost always show themselves in the thigh and not in the leg.  They are generally deep, burrowing along the femur.  The sufferer may die from purulent poisoning, or from prostration consequent upon the profuse and prolonged suppuration.

On account of the great mortality which has been experienced after amputation of the thigh, Stromeyer attempted to save a gunshot injury of the knee-joint by laying open the track of the bullet, and then making on each side of the joint an incision two inches in length through the soft parts and lateral ligaments.‡  The suppuration diminished, and the appearance of the wounds improved, but the patient died in a few weeks from abscesses formed in the lungs.

If amputation of the thigh is performed, it should be done primarily, as secondary amputations have been very unfavorable.  In a few exceptional cases, where the femur has not been injured though the tibia has been shattered, amputation may be performed through the knee-joint.  For such cases, and also those in which the bones of the leg have been severely injured high up, even though the joint be not opened, this operation has for some years been growing in favor.  The ratio of mortality appears to be less than in amputations through the lower third of the femur, and the stump is more useful.

Excision of the joint is hardly to be thought of in these traumatic cases. Out of twelve cases collected by Hodges, only three lived, and one of these kept discharging dead bone for twenty months.

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* Esmarch, op. citat., p. 96.          † Macleod, op. citat., p. 278.
‡ Stromeyer, op. citat., p. 30.

### § 2.—Compound Fractures of the Patella.

**Compound Fractures of the Patella.**—In these cases the knee-joint will usually be found to be involved, but sometimes the patella is broken, and an external wound exist without there being an injury to the joint. Such cases have occurred even in gunshot wounds.

Recovery may readily take place, if the joint is not opened, and without any loss of motion, at the knee.

## SECTION XI.

### WOUNDS OF THE THIGH.

**Wounds of the Thigh** present no very peculiar characteristics. Those on the inner side are most serious on account of the position of the large blood-vessels. In case of a wound of the femoral artery necessitating the application of ligatures, mortification of the whole extremity and death may follow. Great care is therefore necessary in keeping up the temperature until the circulation may be restored by the anastomosing branches.

### § 1.—Compound Fractures of the Femur.

**Compound Fractures of the Femur,** although exceedingly dangerous, do not necessitate amputation, when free from complications, and occurring in the young and vigorous.[*] In the Schleswig-Holstein war, 12 were saved out of 26 cases.[†] This mortality though great is apparently less than that after amputation of the thigh. It should be remembered that the attempt was probably made in the slighter injuries, while the more grave were subjected to amputation.

If the attempt is to be made to save the limb, it is of the greatest importance that the patient should not be moved for any considerable distance. The limb may be kept extended or placed upon a double inclined plane, and during at least a portion of the treatment, it will afford great relief to swing it by means of some suspension apparatus. The strictest antiphlogistic treatment should be pursued.

Resection of the ends of the fragments has proved exceedingly fatal. This operation was performed three times in the Schleswig-Holstein campaigns, but each case died.[‡] Macleod says: "The few attempts that I saw in the East to resect parts of the continuity of the femur were certainly most unfortunate."[§] It is, therefore, only advisable to remove the loosened spiculæ, and leave the separation of the secondary sequestra to suppuration. As the thigh is so large, it is often difficult to remove even the loosened spiculæ. They are generally driven toward the opposite side to that which originally received the injury. It is, therefore, sometimes advisable to cut down upon them in this locality, and remove them.

The inflammation in compound fractures of the thigh is so severe that the tertiary sequestra are numerous and large. They often involve the whole thickness of the bone. In consequence, the progress of the case is exceedingly slow, and at times, even when life is saved, no union of the bone

[*] Stromeyer, op. citat., p. 28.        [†] Esmarch, op. citat., p. 56.        [‡] Ibid.
[§] Macleod, op. citat., p. 263.

takes place.   Stromeyer strongly advises, if the suppuration is profuse and obstinate, that all attempt at extension should be given up, and the limb allowed to retract as much as it will.   He has often observed the suppuration to lessen and the bone quickly to unite, the living portions of it again coming in contact.*   Even when the shortening that ensues is very great it is astonishing how much it is compensated for by a curving of the spine and inclination of the pelvis.   Macleod, however, thinks that the experience of the Crimean war would indicate that any attempt to save the limb is hardly justifiable, unless the injury is of the simplest character and is situated in the lower third.†

The severity of these injuries is greater in the upper portions of the thigh than in the lower; and the fatality of amputations increases, according to Macleod, even more rapidly the higher they are performed.   He therefore urges "that under circumstances of war similar to those which occurred in the East, we ought to try to save compound comminuted fractures of the thigh when situated in the upper third, but that immediate amputation should be had recourse to in the case of a like accident occurring in the middle or lower third."‡   He does not think that the saving of the limb will at all compensate for the protracted suffering, the repeated formation of abscesses and exfoliation of bone, unless the ratio of mortality after amputation is as high as it is in the upper third.   He gives the following table :—

|  |  |  |  |
|---|---|---|---|
| Amputation of thigh, | lower third | .................... | 50·0 per cent. |
| " | " middle " | .................... | 55·3 |
| " | " upper " | .................... | 86·8⅔ |

He thinks that amputation in the upper third is even more fatal than the above ratio indicates.   He says: "I have never, myself, seen any case recover in which the limb was amputated *beyond doubt* in the upper third, and I never met any one who had, except in one instance, and that man was seen in England.   I saw several upper-third amputations, so called, which were not really so.   It is very easy to be deceived on this point.   The French and Russians found these operations so hopeless that they almost abandoned them; and, in fact, as was before remarked, the attempt to save such limbs, hopeless as it was, seemed more promising than amputation in the field."‖

In amputations of the thigh, at least in military service, the primary operations have been found to be less dangerous than the secondary.¶   Therefore the decision should be made at once, whether an operation is demanded or not in any individual case.

It sometimes occurs, at least in gunshot injuries, that the great trochanter is broken without the shaft of the femur being involved.   These cases, although dangerous from the proximity of the hip-joint, and the spongy character of the bone, do not necessitate amputation.**

Whenever amputation is necessary high up the thigh, it should be performed in the continuity of the bone, if practicable, rather than at the hip, as all authorities appear to be agreed that it is less dangerous to life.

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* Stromeyer, op. citat., p. 30.

† Macleod, op. citat., p. 267.

‡ Ibid., p. 328.

§ Ibid., p. 332.

‖ See table given by Macleod, op. citat., p. 335.

¶ Macleod, op. citat. p. 270.

** Esmarch, op. citat., p. 95.

## SECTION XII.

### WOUNDS INVOLVING THE HIP-JOINT.

**Wounds of the Hip-Joint,** uncomplicated by injury to the bone, are seldom seen. The joint lies quite deep, and is protected by the shelving outward of the ilium, and by the prominence of the great trochanter. An injury reaching it is almost necessarily associated with some fracture of the bones.

### § 1.—Compound Fracture of the Hip-Joint.

**Compound Fractures involving the Hip-Joint** are exceedingly dangerous. If left alone, death usually results, amputation is generally fatal, and excision has only as yet saved one patient.

The diagnosis is difficult, as the joint lies so very deep as to be almost beyond the reach of the finger. There may be neither shortening of the limb nor eversion, and at first the patient may be able to move the limb without very much pain.*

Some few cases of recovery have resulted after injuries in this locality, but in them the fracture may not have entered the joint, and these few exceptions to the general fatal result certainly offer no encouragement for their repetition. Amputation at the hip-joint during the Crimean war was uniformly fatal, 23 cases and 23 deaths.† During the Schleswig-Holstein campaigns this operation was performed seven times, and one case only was successful.‡ Macleod has collected, from various sources, 62 cases, and 5 recoveries, or a mortality of 91·9 per cent.§ The great causes of danger are the shock to the nervous system, and the loss of blood at the time of the operation, and also by secondary hemorrhage.

The hip was first excised for injury by Oppenheim, in 1829. The first and only successful case upon record was performed by Dr. O'Leary, during the Crimean war, in 1855. Out of 10 cases collected by Hodges all died except this one, which recovered in six months.‖

In regard to the choice between amputation and excision in these cases, Macleod remarks: "Out of 23 cases of amputation which took place, either in our army or in that of the French, not one recovered, and nearly all died miserably, very shortly after operation. All those, on the other hand, on whom excision was practiced, lived in comparative comfort, all without pain, for a considerable time. Out of 6 operated on, 1 survived for more than a month; 1 died from causes unconnected with the operation; and 1 case recovered entirely."¶ The successful case was a primary one. Stromeyer, writing before any had recovered after the operation, was of the opinion that the operation had better be performed after suppuration had fairly begun, as the difficulty in its execution would be less, and probably the patient would not be so liable to die from pyemia.**

* Macleod, op. cit.
† Ibid., p. 331.
‡ Hodges, op. cit., p. 94.
§ Macleod, op. cit., p. 330.
‖ Hodges, op. cit., p. 93.
¶ Macleod, op. cit., p. 308.
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# PART VI.

## INJURIES OR FRACTURES OF THE BONES.

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### CHAPTER I.

#### STRUCTURE AND GROWTH OF BONE.

The bones, like the soft tissues, are liable to certain changes, which not unfrequently eventuate in a marked departure from their normal condition; thus they may inflame, suppurate, ulcerate, slough, mortify, and be thrown off from the system, while the void thus left will granulate and reproduce a new bony structure by very much the same modifications of local nutritive action that were noted in similar affections of the soft tissues. In fact, in nearly all the injuries and diseases of the bones but little difference will be seen between them and the same affections of the soft tissues, except such as are due to the variations in their chemical composition and density, lime predominating in the bones, while the protein compounds form the chief ingredients of the soft structures. A brief allusion to the structure of the bones will, however, facilitate the comprehension of their diseases, and point out the modifications between their injuries and the same condition in the soft tissues.

**General Structure of Bones.**—Bones present two varieties of structure: an outer or compact tissue, which predominates in their diaphysis as well as in their circumference; and an inner, reticulated, or cancellated structure, which is found in the medullary canal or in the interior of the bones, as well as in their epiphyses and extremities. In the long bones these two structures—the compact and cancellated—are so distributed that the portion nearest the joints, or their articulating extremities, is chiefly composed of cancellated tissue; while the shaft, which is more solid, is formed of the compact matter. But in the short or thick bones the cancellated tissue forms the great bulk of the bone, the compact structure being only a thin shell spread over their surfaces. The bones are also covered externally by a strong, tough, fibrous tissue, which, in adult life, can only be separated from them with difficulty, though less firmly attached in the young bone; while internally in the medullary canal, and throughout most of the cells of the cancellated structure, they are lined by a more vascular and delicate mem-

brane.    These two membranes are generally designated as the external
periosteum and the endosteum, the latter being also known as the medullary
membrane, in consequence of its connection with the soft, pulpy medulla
popularly denominated the marrow, which it supports.    To these two mem-
branes the bones are chiefly indebted for their nourishment, most of the
processes of repair in disease or accident being due to the healthy action
of these tissues.    The supply of blood from other sources than through the
vessels of the external periosteum is comparatively limited, the chief point
of supply being the nutritious foramen of the bone, through which the main
artery enters in its course to supply the endosteum.    As this nutritious fora-
men is a fixed point in all bones, it is easy for a surgeon to recognize the
influence of the position of certain fractures upon it, and to use additional
care in the treatment of any case in which the nutritious supply might be
checked by the fracture, or to explain to his patient beforehand that the
result of such an injury will probably be more serious than it would other-
wise have been.

As the vitality of bone is mainly dependent on the vascular supply fur-
nished through its osseous membranes, the action of the periosteum is essen-
tial to the pathological changes noted in the repair of osseous injuries or
the progress of diseased action.    Without entering into such details as be-
long to special anatomy, it will be useful to note here the fact that the peri-
osteum covers all the bones upon their exterior, adhering closely to them,
and furnishing the material for the growth of the compact matter; the
endosteum, formed like the pia mater and blood-vessels, of loose, con-
nective tissue, lining the internal face of the Haversian canals, and the cells
of the cancellated tissue, and thus regulating their development and diseased
action.    The periosteum is composed of two layers—an outer one, that is
dense, fibrous, and apparently continuous with the ligaments and tendons;
and a finer inner layer, that furnishes the blood-vessels to the bony tissue.
This inner layer increases in vascularity and thickness as bone is primarily
developed, as well as subsequently, under inflammatory action, and evidently
has its nutritive powers modified—that is, under irritation its cells draw an
increased amount of blood to themselves, and furnish a new fibrinous lymph
which, passing through the changes already described under the healing
process in the soft tissues, is first a soft, jelly-like mass that becomes organ-
ized and vascular, but soon, by elective cell power, develops osseous matter
instead of the protein compounds of the soft tissue.

Kölliker, in connection with this point, says:* "The formation of bone on
the inner face of the periosteum is a fact long known, although it was for-
merly thought that it was preceded by a thin, cartilaginous layer, until the
contrary was shown by Sharpey and myself."

Under inflammation the action of both the periosteum and endosteum, or
the ossicles and canaliculi, is modified, and like the soft tissues may create,
first, hypertrophy or atrophy; second, true inflammation of bone, with
simply increased fibrinous exudation, suppuration, ulceration, and mortifica-
tion; or, third, may develop bony tumors.

The experiments recently performed by M. Ollier, and reported† in the
French journals, have also shown not only that periosteum possesses this
reproductive power when attached to bone, but that it is likewise capable of
reproducing bone when separated from it by injury or surgical operations,
as well as of forming bone when transplanted, *attached* or *unattached* to
bone.

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* Kölliker, p. 328, Phila. edit.
† Journal de la Physiologie, 1859, et Janvier, 1860.

Thus M. Ollier has ingrafted the periosteum of rabbits into parts outside the limits of normal ossification, and at the end of a certain period found the formation of true bone the result. The important element in this process, according to this observer, is a layer of blastema on the inner surface of the periosteum, so delicate, that in scraping the periosteum with a scalpel it is difficult to obtain any portions of it visible without the microscope. The new bone thus formed is found at its periphery to possess a regular layer of compact osseous tissue, and to be covered by its own periosteum. It is hollowed in the interior by medullary spaces which terminate by uniting into a relatively large cavity.

In the compact tissue the osseous corpuscles are arranged in layers around the vascular canals, but not with the regularity observable in normal bone.

The medullary spaces are full of a soft, reddish, vascular substance like fœtal marrow.

M. Ollier "concludes by speaking at length of the reproduction of various kinds of bones and joints after resection, and shows that, after the removal of the articular extremities of two contiguous bones, the articulation is capable of regeneration if the capsule and ligaments be left continuous with the periosteum of the resected bone. As a means of diminishing the risk of suppurative inflammation of bone after amputation, and of forming the union of the stump, he suggests that the end of the bone should be covered, and the medullary cavity closed up by a piece of periosteum."[*] From this M. Ollier concludes—

1. That when the periosteum is removed from a living animal and buried in the tissues of another animal of the same kind, new bone is formed.

2. When taken from a recently dead animal and placed in another animal of the same species, bone is also formed.

3. But when the periosteum is taken from a living animal and ingrafted in an animal of a different species, this action[†] is not, however, similarly successful, the experiment furnishing negative results.

In the consideration, therefore, of the pathological changes noted in the injuries and diseases of bones, the action of the periosteum, as well as of the cancellæ, must be looked on as the starting-point and agent for the accomplishment of the condition noted. Without the congestion and inflammatory action of the periosteum, the repair of injuries of the bones is as impossible as the healing of a wound in the soft tissues without the organization of fibrin. This fibrin is the element of repair in both instances; that it ultimately forms bone in the repair of bone, instead of the structure found in the cicatrices of wounds, is solely due to the elective cell action of the inner or jelly-like layer of the periosteum. When in open wounds of bone the granulations formed in the healing process by the endosteum protrude, as in bones sawed across in an amputation, they form cancellated tissue, until being blended with the fibrin from the periosteum, compact matter covers them, precisely as the skin of a cicatrix in the skin covers the granulations formed by the deeper-seated tissues. These points will be again referred to in connection with the failure of the healing process in fractures, designated as "False Joint."

In the methodical arrangement of the injuries and diseases of the bones, we might most naturally study those connected with the periosteum, as periostitis, and then, passing to its effects, examine ostitis, caries, necrosis, and fractures. But as fractures are a class of disorders of the bones most frequently met with, they will be presented first.

* British and Foreign Med.-Chirurg. Rev., from Journal de Physiol., June, 1859.
† Op. citat., p. 90.

# CHAPTER II.

THE subject of **Fractures,** or the solutions of continuity in the bony fibres, caused either by mechanical violence or muscular action, is one that demands the most careful attention of the student, not only in order to prevent deformity of the limbs and the imperfect motion which results from the improper treatment of such injuries, but also to protect the reputation of the surgeon, and insure the proper performance of his duties. Nor is this subject less important to every medical man, whether professing surgery or limiting himself to the practice of medicine, as all practitioners are liable to be called on to render assistance in the emergencies which usually give rise to these injuries, and these, if not satisfactory, leave such results as often expose him to the evils of a "suit for damages" by a vicious or designing patient.

Indeed, when a case turns out badly even in the hands of a most able surgeon, the friends of the patient, to use the language of Mr. Amesbury, "sometimes think they can never injure his reputation sufficiently; and though in many instances he is not at all deserving of blame, they usually load him with epithets of ignorance, neglect, and presumption. If we examine a little into this feeling we shall find that it is nothing more than what is naturally to be expected. Patients, as a general rule, know nothing scientifically of the nature of fractures, or of the means required for their cure; consequently they judge of a surgeon's ability only by the result of his case. If it terminates well, he has only done his duty; but if the limb be deformed, the patient will immediately say that the fracture was badly set, and be confirmed in this opinion not only by the observation of his friends, who seldom fail to find out cases to substantiate their belief," but also by every empiric who may be interested in the professional destruction of his attendant.

**Definition.**—A fracture has been very correctly defined as "a solution of continuity in the bony fibres, which is the result either of mechanical violence or of muscular action." It is generally accompanied by more or less injury to the surrounding soft tissues.

**Etiology.**—The causes of fracture may be divided into those which are predisposing and those which are immediate or direct.

**1. Predisposing Causes.**—The predisposing causes of fractures are— the *exposed position* of the bone. Hence the long bones, especially those of the extremities, which are situated between powerful muscles, are most apt to suffer from fracture. The *diathesis* of the patient has also a marked influence in their production, syphilitic and cancerous patients suffering from fractures upon the slightest immediate causes. *Occupation*, also, has its influence; workmen, and those exposed by their trades to falls or blows, being more liable to these injuries than others.

**2. Immediate Causes.**—The *immediate causes* of fracture may be di-

vided into two varieties—mechanical violence and muscular contraction, both of which create fractures by overcoming the natural adhesiveness of the bony fibres. These forces may be applied in various ways, the mode in which fractures are created being innumerable.

**Varieties in Fractures.**—Fractures have been classified—first, according to the nature of the injury; and, second, according to the direction in which the bony fibres yield. According to the nature of the injury, they are usually divided into simple, compound, comminuted, and complicated; while in accordance with the direction in which the fibres of the bone have yielded, they are classified as transverse, oblique, longitudinal, fissured, stellated and depressed, each of which has its special peculiarities.

I. ACCORDING TO THE NATURE OF THE INJURY.—**A Simple Fracture** is one in which the fibres of the bone have given way without any *external* solution of continuity in the adjacent soft parts, though the latter may have been bruised, or even lacerated internally.

**A Compound Fracture** is one in which a wound has been made in the outer surface of the soft parts over the bone, by which the atmosphere can communicate with its broken ends. This wound may be made either by the fragments of the bone being driven through the surrounding soft parts, or by the same violence which produced the injury. To comply with this defi- nition of a compound fracture the wound must therefore communicate with the fragments of the bone, otherwise the injury would properly be only a simple fracture complicated with a wound.

**A Comminuted Fracture** is one in which the bone has been broken into two or more pieces.

**A Complicated Fracture** is that which is accompanied by some other injury, such as laceration of the blood-vessels or nerves of the limb, etc.

II. ACCORDING TO THE DIRECTION IN WHICH THE BONY FIBRES YIELD.— **A Transverse Fracture** is one in which the fibres of the bone have given way transversely to its long axis.

**An Oblique Fracture** is that in which the fibres have yielded obliquely to its axis.

**A Longitudinal Fracture** is one in which the division of the bony fibres runs parallel with the axis of the bone.

**A Fissured Fracture** is one in which there is a simple crack; the term being generally limited to fractures of the cranium.

**A Depressed Fracture** is also generally confined to the cranium, in which some part of the fragments is depressed below the level of the surrounding portions of the skull.

**A Stellated Fracture** is an injury of the bones of the head, in which the fissure assumes a radiated, star-like shape.

**Causes of the Deformity in Fractures.**—As the bones serve for the points of attachment of muscles, and the action of the latter is resisted by the continuity of the bony fibres, it follows that in the event of a fracture the action of the adjacent muscles, or those connected with the fragments, will be imperfect, and that the fragments themselves will thus be liable to be drawn out of their natural line, whence deformity of the limb will ensue, as well as displacement of the broken ends of the bone.

This muscular contraction tends toward the reproduction of deformity until the bones have become again firmly united, a fact which should be borne in mind throughout the entire period of treatment. The popular idea is, however, quite the reverse. Thus the ignorant conceive that a bone once set is always set, and often blame the surgeon first seen for having "set the bone wrong;" when the person deserving blame is really the second or third attendant in the case, or the patient himself, by whose constant muscular

action, when unresisted by proper mechanical contrivances, the bone is repeatedly displaced.

**Displacement** of the fragments after a fracture may also be produced at the moment by the force creating the injury, as well as subsequently by muscular contraction after the fracture has occurred.

Displacement after fracture may occur in five different directions:—

1. Displacement, in accordance with the *length* of the bone, is one in which the fragments are drawn upon each other, as in oblique fractures; it produces marked shortening of the limb. By it the free surface of the external periosteum of one fragment is liable to be brought into contact with the free surface of the internal periosteum of the other, and, as these two structures differ in vascularity, there will often be such a difficulty, in the formation of callus, as will retard the cure and increase the probability of the formation of an artificial joint.

2. A displacement, in accordance with the *thickness* of the bone, is that which is produced in transverse fractures when one fragment rides the other. Here, the medullary canal of both fragments being exposed, and the external periosteum of one fragment brought into contact with the external periosteum of another, it becomes a question whether these two surfaces can unite, a question which will be more fully alluded to subsequently under the head of Callus.

3. Displacement, in accordance with the *circumference* of the bone, or that in which one or both fragments rotate upon their axes, interferes not only with the formation of callus, but with the subsequent usefulness of the limb; thus, if such a deformity should become permanent in the femur or tibia, the foot would be turned inward or outward by the rotation of the lower fragment, and the patient would walk upon the inside or outside of his foot instead of upon the sole. In the humerus the elbow would be apt to present inward, outward, or even forward, and the position of the hand would, therefore, be such as would materially interfere with its usefulness as well as with the comfort of the patient.

4. An *angular* displacement is one of the most common of those consequent upon fractures, and is invariably produced when the muscles on one side alone act, or when the two sets of muscles act unequally. Thus, in a fracture of the leg, in which the heel is not well supported, there will be more or less angular displacement of the upper end of the lower fragment, but this displacement usually interferes but little with the formation of callus.

5. The fifth displacement is that present in *impacted* fracture, in which one fragment is driven into the other by the force producing the injury. In this displacement the external periosteum of one fragment, or the bone denuded of its periosteum, presents to the internal periosteum of the other, in consequence of which difficulties in the formation of callus, as well as shortening, angularity, etc., are very likely to ensue.

**Symptoms.**—The symptoms of fractures are divided into two general classes: 1. The rational. 2. The physical.

1. The *rational symptoms* of fracture are readily recognized; thus, the patient suffers pain, which is generally acute and often intense. Indeed, so marked is the pain from a fracture that it has been said that the accident may be recognized by the cry of the sufferer at the moment of its occurrence, or at the first dressing. Frequently, however, there is impaired or irregular sensibility of the affected limb from the pressure of the fragments upon the nerves supplying the part. There is also more or less inability to perform perfectly the functions of the limb; thus, if the fracture affects the femur or tibia, the patient will be unable to stand, while if it is the humerus, he will be unable to perform the usual motion of the arm, which hangs as a dead weight at his side.

2. Among the *physical signs* of fracture, the most important is that of *crepitus* or *crepitation*, or that sensation caused by the friction of the fragments against each other. This sensation has been compared to the impression made upon the sense of touch and hearing by rubbing two pieces of loaf-sugar or similar porous bodies together. In order to diagnose this condition, which is often rather *felt* than heard, the inexperienced observer should exercise every caution; but once perceived, there will be little difficulty in recognizing it again. In some cases it is quite difficult to distinguish the crepitus of a broken bone from other conditions, as a diseased state of the bursa connected with certain tendons, where, owing to lymph being effused into the cavity of the bursa, the movements of the tendon produce a sensation which has been confounded with the crepitus of fractures So also the impression made by the motion of a joint during inflammations of its structure Both these conditions, however, give the impression of the action of moist surfaces, while the crepitus of fracture gives rather the idea of the friction of two dry porous bodies upon each other. Emphysema of the areolar tissue is accompanied by a crackling upon pressure, which, under some conditions, might be mistaken for the crepitus of fracture, but a diagnosis may be readily made by noticing that the crackling or crepitation of emphysema is superficial, while that of fracture is deeper seated.

Besides crepitus, the physical signs of fracture consist in increased or diminished mobility, in displacement or deformity of the part, and in loss of motion, or too great a degree of mobility.

**Diagnosis.**—The enumeration of the symptoms just given would apparently render the diagnosis of all fractures easy, and, except when near an articulation, the liability to error is not very marked in the long bones. In the bones of the cranium and the short and thick bones of the carpus and tarsus, the diagnosis of the injury is, however, often a matter of difficulty. As the special diagnosis of each fracture can be best studied in connection with the seat of the injury, it is only necessary in this place to call attention to a few general points. Thus crepitus may exist without a fracture, as just stated; deformity may be present and be due to bending of the bone, or a luxation; an impacted fracture may exist without crepitus or increased mobility, or a destruction of the function of the limb being noted; variation in length, if slight, may be caused by inaccurate measurement; but, by the use of the stethoscope, or simply by the ear applied to one extremity of the limb, while such motion is made as will change the relations of the fragments to each other, crepitus will be heard and probably felt in all fractures. Although severe pain sometimes accompanies a sprain, yet it is not so severe as that indicative of a fracture, while the locality of that of fractures, in many instances, is distant from a joint. Great care is therefore necessary in the diagnosis of all fractures, especially if near an articulation, and in cases of doubt the patient should be fully etherized and carefully examined, the muscular relaxation thus induced greatly facilitating the diagnosis.

**Prognosis.**—The prognosis of fractures will depend upon the age, constitution, and habits of the patient, his obedience during treatment, as well as on the extent and nature of the injury.

As a general rule, the fractures of the aged, if they unite at all, unite more tardily than those of the young. There is also more endurance, more vascularity, and more ample formative and reparative power in the young than there is in the old. The prognosis is, therefore, most favorable in the fractures of the young. The result will also vary with the bone that is broken and the line of the fracture; that of a single bone situated between powerful muscles, such as the humerus or femur, being more difficult to treat successfully, and without deformity, than one in which two bones are con-

cerned, particularly if but one of them is broken, as the radius or the tibia; since in this case the other bone, the ulna or the fibula, acts as a splint, so as to keep the parts at rest and prevent shortening. The rapidity of the cure, and the probability of deformity, are affected, moreover, by the nature of the fracture, whether it is impacted, simple, transverse, or oblique.

The social position of the patient has also its influence on the prognosis. If in wealthy circumstances, surrounded by all the luxuries of life, and able to obtain the little comforts and attentions so necessary for the sick, the chances will be better than when a fracture occurs among the laboring classes. On the other hand, these men have generally more robust frames and better constitutions, and hence their chances are better than too many of the wealthy, who are liable to be debilitated by their mode of life. The general health of the patient also influences the rapidity of the cure, and even the chances of life. The relation of the bones to certain cavities should, moreover, have its weight in the prognosis, the injury being always severe in fractures of the pelvis, on account of the liability of injury to the viscera, either by the force producing the fracture or by the effusions which are apt to ensue. But in every fracture the prognosis should be guarded, as the result may from various causes ultimately be different from that which was to have been anticipated. While I cannot but regard as dangerous the doctrine that few fractures are healed without some deformity, believing that it encourages inattention on the part of the surgeon, and leads him to be satisfied with an imperfect result, yet it is wrong ever to induce any patient to think that a broken bone will certainly heal and be the same in all respects as before the injury. The works of Hamilton, of Buffalo, and Malgaigne, of Paris, with that of Sir A. Cooper, have accumulated many instances of failure, and every surgeon knows of others. While, then, the prognosis should be guarded as expressed to the patient, the surgeon should yet recollect that the cure with a useful limb depends greatly on the skill and attention that he bestows on the dressing. Ignorant dressers are a curse to any community, and the law sometimes decides that they are so, and fines them accordingly. When proper skill and assiduity has been exercised, the law, however, does not hold a surgeon answerable for the result, even if his prognosis was favorable. When the varied circumstances attendant on fractures and the character of patients is recalled, the surgeon must see the importance of not exciting too much hope of a perfect cure, and especially of impressing on the patient the fact that his entire submission and obedience to the surgeon's orders is essential to success, and part of the contract.

**Process of Repair in Fractures.**—As it is absolutely essential to a cure that there should be the formation of a proper amount of reparative material, in the healing of the injuries of a structure which, like that of a bone, must gain a considerable degree of close consolidation before its functions can be correctly performed, the investigation of the process of union has always been most carefully conducted. From an early period of surgical science, the mode of union in fractured bones was regarded as one of the most interesting questions in surgery, and the physiology of the reparative action has since then received general attention, so that its course is now well understood.

**Callus**, or the material furnished by nature for the union of the broken ends of a bone, is an example of the modification of structure created in an effusion of lymph by the action of the tissues concerned in the injury. In its formation, the same general steps may be noted as were seen in the effusion of that plasma which served to repair the injuries of the soft tissues. As the cause creating a fracture is always productive of considerable laceration of the vessels of the adjacent tissues, an effusion of blood into the sur-

rounding parts is usually noted soon after the occurrence of the injury. This blood being effused within the integuments, soon creates more or less swelling, as well as discoloration of the skin, at or near the seat of fracture, rendering the limb black and blue to some distance from the part, and especially in the line of the muscles which have been most violently strained at the time of the accident. Like the effusions of blood in wounds, this blood is foreign matter, and is therefore soon acted on by absorption, or ultimately discharged by suppuration, while the inflammatory action developed

Fig. 201.



DIAGRAM OF THE EARLY STAGES OF UNION AFTER FRACTURE OF THE HUMERUS.—1. The pouch of blood and the ends of the bone surrounded by it. 2. Plasma occupying the place of the extravasated blood. 3. Organization advanced in the callus, which now holds the fragments as in a ferrule. (After Miller.)

by the injury leads to an effusion of plasma around the bone, and to the steps of organization already explained in the organization of fibrin, p. 217. In addition to the laceration of the fibres of adjacent tissues, a fractured bone is also generally attended by some laceration of its periosteum, and the inflammation developed from the injury of this membrane has a marked influence in regulating the character of the deposit which occurs around the broken ends of the bone.

Starting with the statement, that every fracture lacerates not only the bony fibre, but also usually more or less of the periosteum, the changes consequent on the repair of the injury will be found to consist in—1st. Increased vascularity of the lacerated periosteum. 2d. Increased action in the Haversian ossicles, canaliculi, and bony fibres, the inflammatory action developed by the injury in the surrounding soft tissues resulting in such changes as have been already alluded to under the head of Contusions, Wounds, etc., a fact well established, and that settles the origin of the bond of union. In accordance with the opinions now entertained by the best pathologists, the repair of injury in bone or the "formation of callus," to use an old well-

known phrase, is thus accomplished in simple fractures, there being a slight modification of the process in compound fractures, as there was between the healing of open and subcutaneous wounds.

When in a simple fracture the reparative process is studied, it will be found to consist in several periods, which may be distributed as follows:—

1st. An effusion of "structureless or granular substance like fibrin," as the result of inflammatory action in the lacerated periosteum, bony fibre, and cancellated structure, (Haversian canals and ossicles,) on the medullary canal.

2d. The organization of this, and its conversion, under the cell power of the tissues involved, into a fibro-gelatinous or fibro-cartilaginous tissue.

Fig. 202.
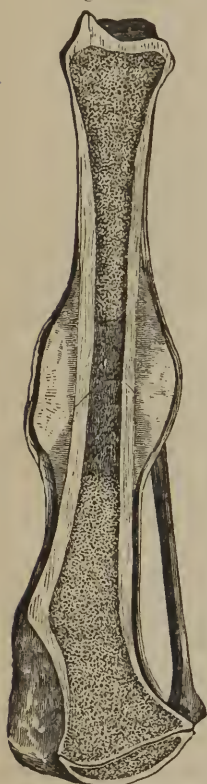


A view of the Ensheathing Callus in a Dog's Tibia, showing that it accumulates solely between the wall of the bone or its compact tissue and the external periosteum, which is thus lifted up from the bone, while the blood-vessels which passed from it to the bone in the natural state now pass to their destination through the callus. (After Paget.)

3d. The continuous development of this tissue into a "finely and very closely granular osseous deposit,"* "cancellated or spongy bone structure,"† which to some extent takes on ultimately the character of the compact layer of healthy bone.

These periods vary greatly in duration, in accordance with the bone broken and the circumstances of the case, as will be hereafter explained.

The relative position of this new material to the old structure in the repair of fractures has been much discussed. The ancients, and in France, especially Dupuytren, regarded it, as shown by experiments on animals, to be formed both around as well as within the ends of the fragments, the exterior mass acting, as he thought, as a temporary splint or "provisional callus," and the internal pin, or that found between the ends of the fragments, as the "definitive callus." Modern writers have, however, denied the correctness of these statements as applied to the healing of fractures in man, though admitting them, as a general rule, in connection with the fractures of animals. Among these Paget especially speaks authoritatively, "having never seen provisional callus in man in any bones but the ribs."‡ Subsequently§ he admits "having seen it in the clavicle and humerus in which the repair had been disturbed by constant movements of the part." We may I think safely admit that in a well-treated fracture the process of repair consists in the ultimate formation of callus by the action of the inner layer of the periosteum, which thus surrounds the bone, and is therefore well named as the "ensheathing callus," while the lacerated fibres of the compact and cancellated bony tissue are united by "intermittent callus," in some instances promptly, in others more tardily, this being formed through the influence of the increased nutritive power given to the normal bone structure by the injury. In fact, if the difference in the chemical composition of bone and of soft tissues is overlooked, analogy and observation would long since have convinced the observer that it was un-

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* Paget.
† Malgaigne.
‡ Lectures on Surg. Path., Phila. ed.
§ Op. citat., p. 167.

necessary to seek for any other reparative process in a fracture from that seen in the repair of wounds of the soft tissues.

In the repair of injuries to the bones, as well as in those of the soft tissues, we must admit that certain conditions are necessary. Thus, first, there must be upon the part of the patient a sufficient degree of vital power to keep up the necessary amount of reparative action; and second, there must be an absence of such stimulants as might induce excessive inflammation, and result in suppuration, or an absorption of the callus, a condition which may ensue upon a too early, violent, or otherwise improper motion of the fragments.

In compound fractures the process of repair resembles the healing of wounds by the second intention, that is, granulations form from the fibrin, and these granulations form nucleated cells by which ossification is ultimately accomplished. These granulations come with the organization of the fibrin from the internal surface of the external periosteum, from the compact structure of the bone itself, and from the medullary membrane, as may be demonstrated by an examination of the extremity of a bone in the stump formed by an amputation, where they may be seen sprouting from all these sources, and where they are found shooting up, spreading out, and forming a mushroom-like mass at the extremity of the bone.*

Any deviation from these processes of repair results in a modified callus. Thus, certain circumstances so change the conditions necessary to its perfect formation that merely a fibro-ligamentous structure results, and some bones consequently present these conditions so invariably that they seldom if ever obtain bony union; as, for example, the femur within the capsular ligament, the patella, olecranon, etc.

The process of repair in fractures may be divided, for the purposes of study, into two periods: 1st. The uniting period, during which the ensheathing and definite callus are formed. 2d. The modeling period.

1. The *uniting period* presents first a stage of inflammatory exudation, which continues for the first two to four or five days after the injury, and, with the effusion of blood already alluded to, produces the tumefaction that is seen after fractures.

Then there is a period of four or five days of apparent inaction with a decline of inflammatory action, a period of calm after the storm; accompanied by diminution in swelling, pain, and all the inflammatory symptoms. These two periods together give, it will be perceived, from eight to ten days, during which little has apparently been done directly for the repair of the injury. The third stage, commencing in the neighborhood of the tenth day, and lasting from ten to twelve days, is the formative stage, in which the reparative tissue is developed by an organization of the lymph, as thrown out. This is the period popularly designated as the "knitting" period, during which the patient will often say he can feel the bone knitting, which of course is an erroneous idea, though what causes the sensation, whence the patient obtains this notion, cannot be told. We have thus obtained a period varying from twenty to thirty days, during which usually no osseous matter has been deposited. It is impossible to limit these periods nearer than by the generalization above given, for they vary with the age, the bone broken, the degree of inflammatory action, and many other circumstances. In the fourth stage *osseous matter* begins to be deposited, and soon exhibits the true characteristics of normal bones, such as the formation of the Haversian ossicles, canals, etc., though these are not presented in the fully developed state of normal bone; nor does callus itself correspond precisely in its chemical ele-

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* Paget's Lect., Phila. edit., p. 163.

ments with the proportions of these elements as found in normal bone. Thus Becquerel and Rodier* give the following analysis of *callus* as made by Lassaigne :—

| | External portion of callus. | Internal portion. |
|---|---|---|
| Phosphate of lime | 33·3 | 32·5 |
| Carbonate of lime | 5·7 | 6·2 |
| Soluble salts | 11·3 | 12 8 |
| Animal matter | 50·0 | 48·5 |

According to Berzelius, *adult bone* contains :—

Fig. 203.



A view of the Condition of a Bone after the *modeling process* has been conducted through its different stages, showing the removal of the sharp points and edges of the fragments, the closing in or covering of the exposed ends of the medullary canal, the forming of a compact external wall and cancelous interior for the reparative new bone, and lastly, the continuity of these with the walls and cancellated tissue of the fragments. (After Paget.)

| | |
|---|---|
| Phosphate of lime | 51 13 |
| Carbonate of lime | 11 30 |
| Soluble salts | 14·60 |
| Animal matter | 32·17 |

Thus showing an excess of animal matter and deficiency of calcareous matter in callus, as compared with normal bone.

The stage of ossification in the formation of callus is of an indefinite length, varying in different bones, and on account of diverse circumstances not always precisely noted.

2. During the modeling period, which trenches somewhat on the last stage of the first period, sharp fragments and spiculæ of bone are removed or rounded off; any great excess in ensheathing callus disappears; cells are developed on that part of the definitive callus which encroaches upon the medullary cavity of the bone, and the cancellated structure is reproduced to a greater or less extent, as in Fig. 203.

The time required to effect such a degree of union as will permit the patient with safety to dispense with his splints and bandages, and begin the motion of the limb, varies according to the bone injured. Thus, in the clavicle it is about five weeks; in the humerus six or seven under favorable circumstances. In the case of the femur it would hardly be safe for him to walk before twelve weeks or three months; and in the tibia it requires about eight weeks. But it must be remembered that some fractures never unite by callus, that condition resulting which is hereafter spoken of as "false joint," or more properly, "ununited fracture;" besides which certain fractures, as before stated, unite only by ligamentous matter, the callus never becoming bone.

**Period for reducing or setting a Fracture.—** As a broken bone is a constant source of irritation to surrounding parts, and the periosteum is liable to be separated to a greater extent in proportion to the spasmodic motion of the muscles, it is singular that any doubt could exist as to the advantage of setting a fracture as soon as possible.

* Traité de Chimie Pathologique, p. 543, et supra.

When immediately coaptated, the fractured ends are placed in a condition similar to the edges of a recent wound in the soft tissues, the prompt approximation of which always facilitates union by the first intention. When, then, a fracture is well and immediately adjusted, the union is more equable and the cure quicker than in cases in which adjustment is delayed. While inflammatory swelling is likely to increase, it is of course important to employ such means of retention as will not interrupt the circulation of the limb by undue pressure, but no fear of spasmodic muscular contraction, or of inflammatory swelling or gangrene, should be permitted to warp the judgment and leave a fractured limb unprotected, sound sense dictating such arrangements as will be appropriate to the end in view. In most cases even of severe spasm, the use of anæsthetics will overcome it, and full doses of anodyne for forty-eight hours tend to prevent its recurrence. Then, extension and counter-extension, with lateral pressure of a turn here and there, and not the continuous encircling pressure of a tight bandage, will keep the fragments at rest without interrupting the circulation. So important do I deem it to set a fracture promptly, that I always employ temporary means, if delayed by a want of apparatus at the moment; a fractured thigh, for example, being held in position by tying a counter-extending sheet from the perineum to the head of the bedstead, while the extending band is made fast to the post at the foot; then, when the apparatus is ready, assistants are so placed as to keep up extension and counter-extension until the splints are adjusted. But when a fracture is not seen until inflammatory swelling is marked, it will be useless to attempt accurately to adjust it at the first dressing, as the pain from the tension of the apparatus will generally compel its removal or risk the development of gangrene. In such cases the better plan is to reduce the fracture as far as it can readily be done, and apply the cold water-dressing; then, when inflammation has subsided, say within ten days, readjust it accurately, and, if necessary, resort to the use of ether.

Treatment.—The treatment of fractures may be considered as resolving itself into four stages.

The first stage relates to those general rules which must be obeyed in all fractures of sufficient magnitude, such as directing the manner of removal of the patient to his dwelling, of placing him in bed, etc., and will be again referred to under Fractures of the Lower Extremity, in which it is especially demanded.

The second consists in the reduction, or, as it is termed in common language, the "setting" of the fracture.

The third embraces the application of such dressings as are necessary to prevent displacement of the fragments by muscular action.

And the fourth stage includes the treatment of the complications and constitutional disturbances, which result from the injury or follow the dressing, as fever, chafing, ulceration of the skin, anchylosis of the joints, etc.

A few words devoted to the explanation of each of these stages, so far at least as they are applicable to fractures generally, will save much unnecessary repetition in the consideration of particular fractures, and aid the inexperienced surgeon in the details of his duty.

Reduction of Fractures.—The means to be employed in the reduction of the fractured ends of a bone consist essentially in extension, counter-extension, and coaptation.

By *extension* is meant the force that is applied to the fragment farthest from the centre of the body, with the view of drawing the bone into its place. By *counter-extension* is meant that which is applied to the fragment nearest to the body, or to the body itself, with a view of resisting the extending force. Thus, for example, in a fracture of the humerus, if the extension is applied

at the wrist, and no counter-extending force applied, the extension might simply draw the body out of line; but when, by a properly adjusted counter-extending force, the upper fragment and the body are rendered a fixed point, the extending force is enabled to draw the fragment into place. Hence, the counter-extending force must be equal to the extending force, excepting only the degree of power which must be applied to the lower fragment before the *vis inertia* of the upper fragment is overcome. But in some instances, even in fractures of the extremities, as in fractured patella, olecranon, etc., it is improper, if not impossible, thus to make extension and counter-extension, and we are obliged to resort to position, or placing the muscles in a state of relaxation, in order to accomplish our object. The advantages derived from this latter point (position) has for many years been a disputed question among surgeons, Pott, and many of the English school, contending for its advantages, while the French and American writers advocate the more mechanical means of treatment, averring that position alone would prove injurious to most cases. As in most disputes, opinions have been urged to extremes to the injury of all parties. That in many cases extension is absolutely necessary to the reduction of a fracture, cannot be doubted, but that position is also not to be neglected, is equally indisputable. Take, for example, a fractured clavicle; the mere extension effected by carrying the shoulder outward would not relieve the deformity without attention being also paid to the position of the shoulder, viz., carrying it backward and upward. Again, a fracture of the femur or of the leg would not be properly reduced by mere extension and counter-extension, unless at the same time the position of the foot was attended to. The prudent practitioner will therefore bear in mind simply the fact, that it is the force of muscular contraction that is to be overcome; and whether this is accomplished in an extended or flexed position, by compression of bandages, or without them, not rest satisfied until he has accomplished this object. In fractures of the long bones the weight of French and American authority is in favor of the extended position of the limb; while the pupils of Pott, and many of the English surgeons, still prefer the flexed, especially in the treatment of fractures of the lower extremities. The accomplishment of this is usually the result of the employment of a certain force more or less directly to the seat of fracture.

Where two bones are parallel and it is important to keep them at a certain distance, as in the bones of the forearm and leg, or where one fragment is liable to such irregularity of position as cannot be otherwise overcome, it becomes necessary for the surgeon to press upon them with his fingers and mould them to the desired condition, thus *coaptating* or *setting* the fracture. But where the deformity can be remedied by the action of muscles it is better not to finger the seat of fracture, as the pressure of the soft parts on the sharp points of bone might create such irritation as would rather increase than relieve the existing symptoms.

The object of the extending and counter-extending force being to remove displacement by overcoming the muscular action which produces it, these forces, to be efficacious, must have sufficient power to overcome the strength of the spasmodically contracted muscles; and a slighter degree of force will answer, if means are employed calculated to promote relaxation in the muscular tissues.

It is better, therefore, not to attempt immediately fully to overcome the spasmodic contraction of the muscles in a case of fractured thigh or a badly fractured humerus, without obtaining perfect muscular relaxation, as may readily be done by means of anæsthetics. The advantages of this latter mode of proceeding are to be seen in the facility with which these powerful muscles, which are usually so difficult to relax when spasmodically contracted, can be

mastered by the strength of a single assistant. Not only is pain to the patient avoided, but the nervous shock and violence which predispose to inflammation, are obviated by a simple and safe mode of proceeding. Hence, I do not hesitate to recommend the use of anæsthetics in the reduction of every case of fracture of a bone acted upon by powerful muscles, provided there is no affection of the brain or heart.*

**Retention of Fractures.**—As the muscles are the motive powers of the body and are attached to the bone, it follows that, even after the setting of a bone, any sudden action on their part must tend to displace the fracture; so that the common idea of a bone once set being always afterward in its proper position, is incorrect, the facts being most frequently the reverse, the attention of the surgeon to the state of the bone being always required at each dressing, until consolidation has taken place, lest the action of the muscles again displace it. In order to guard against such changes, various means are employed, as splints, cushions or junk-bags, pads, extending and counter-extending bands, etc., as will be detailed hereafter in connection with Special Fractures.

It may, however, be here stated that the employment of any splint, or bed, or apparatus which is *patented*, should be disconntenanced, as derogatory to the tone of the profession, and as tending to advance the petty interests of the inventor at the expense of suffering humanity. Most of these splints are also complicated, while there is no fracture, that I know of, that cannot be well and readily treated by such an apparatus as may be easily made in any civilized locality. In the splints hereafter alluded to, simplicity of construction, efficiency of action, and facility of obtaining will be specially regarded as rendering them valuable. As most practitioners are called on suddenly to treat fractures, the use of simple forms of apparatus tends greatly to facilitate their operations, while those who employ such will have the satisfaction of acting in accordance with that clause in the code of ethics adopted by the American Medical Association, which states that it is "reprehensible for physicians to give certificates attesting the efficacy of patent or secret medicines, or in any way to promote the use of them," these splints being only surgical remedies, not one in ten of which are worth the cost induced by the holding of a patent by some avaricious manufacturer, who cares more for his pocket than for the good of his fellow-creatures. The pure benevolence of the profession cannot be too strongly upheld in resisting all attempts by patentees to advance their own interests by using surgeons as their tools.

After attending to the reduction and retention of the fragments of a broken bone in their proper position, the sequences of the injury demand consideration. These necessarily vary greatly, in accordance with the seat, cause, and character of the fracture, but may generally be alluded to under the following heads:—

**Contusion.**—As the degree of contusion differs in proportion to the peculiar cause inducing the fracture, general indications can alone be stated, and of these the most important is to prevent such subsequent inflammatory action as will result in suppuration or ulceration of the contused tissues. If the patient is young and vigorous, the cold water-dressing will be found very useful; but if the reverse, stimulating applications, as cloths wet with volatile liniment, brandy, etc., will often prove necessary in order to counteract the local paralysis of the tissue that eventuates in sloughing or ulceration. When a contusion is severe, and blood has been freely effused beneath the skin, cold astringent applications, as lead-water cloths, are often highly serviceable; but no attempt should be made to evacuate the blood by

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* For the administration of anæsthetics, see p. 169.

a puncture of the integuments, such a practice being likely to convert a simple into a compound fracture, a result always to be deplored. In the fractures caused in mines, or by banks of earth falling on the limb, I have frequently seen the most extensive effusions of blood ultimately absorbed—the delay of the repair of the fracture being certainly not greater, and the result not as uncertain as in compound fractures. All marked pressure by apparatus should of course be kept from a contused surface; and should ulceration occur, every effort should be made to induce it to heal under the artificial scab hereafter described in connection with Compound Fractures.

**Paralysis of the Bladder.**—The next symptom demanding attention in many cases of fracture, and especially of the head, spine, or lower limbs, is a difficulty in voiding the bladder. This is especially noticeable in fracture of the leg or femur, when the patient is compelled by the apparatus to lie on his back. It may be due to the congestion of the spinal marrow thus induced, or sometimes to the shock of the injury. Catheterism every twelve hours should be performed until the necessity passes away.

**Inflammation** and **Erysipelas**, when supervening on fractures, are to be treated on the principles before alluded to under these heads.

**Fever.**—When febrile action supervenes in a fracture it may be the result of the injury, or of indiscretion of diet, ingesta, etc., that existed before the injury. In either case it should be met by the treatment described under the head of Irritative Fever.

**Mania a Potu.**—The supervention of mania a potu, or delirium tremens, on the occurrence of a fracture, is only met with in the intemperate. Such cases demand the employment of a dressing that will insure the rest of the fractured bone; while the free use of alcoholic drinks and opiates, or, what is preferable if judiciously employed, the tincture of digitalis in ℨss doses every six hours, until three doses are given, the pulse being carefully watched, may be demanded in this complication.

**Tetanus.**—This disorder may appear at any moment, but is usually not developed until after the fifth day of the injury. Its treatment is that detailed under the appropriate head.

**Bed-sores** and **Ulcerations** of the integuments, from pressure of some portion of the apparatus, are to be treated as before described.

**Diet.**—On the occurrence of a fracture in a person previously in full health, it should be remembered that inflammatory action is to be anticipated, the extent of this being regulated by circumstances. Until, then, forty-eight hours have elapsed, the patient should live lightly. If after this no febrile action is apparent, he may resume his usual food, and if digestion is active, live on a fully-nutritious diet until the cure is accomplished, prudence being exercised to guard against the effects of repletion of the stomach, especially when exercise is impossible, as in fractures of the lower extremities.

**Purging.**—The propriety of the administration of cathartics is to be decided on such reasons as would regulate the course of every intelligent physician.

**After-consequences of Fractures.**—In cases of fractures of the limbs, the perfect rest of the fragments generally also demands rest of the joints. Hence the synovial fluid is not freely secreted, congestion and thickening of the articular ligaments supervene with sometimes false anchylosis from the development of inflammation in the fascia, bursæ, etc. exterior to a neighboring joint. Atrophy of the muscles is also frequently seen, and the patient consequently finds a difficulty in subsequently using the limb. When the joints are small, as on the fingers, these results are often met with, though also noticeable in a marked degree in the larger articulations, as on the knee after fractures of the femur. Should inflammation be present, this must first

be combated by rest, and the antiphlogistic system applicable to acute arthritis, as hereafter detailed; but if due to chronic induration, atrophy or want of exercise, passive motion, even with moderate force, should be practiced and persevered in for weeks, or at each dressing of the fracture. In the later stages the cold douche daily, with friction and motion of the joint, will be absolutely necessary, the muscular atrophy being relieved by the use of the electro-magnetic apparatus, so as to keep up the local circulation.

**Vicious or Deformed Union.**—When, from neglect or the complications of the injury, a fracture unites with deformity, little can be done except to refracture and reset it in a better position, or perform a resection of the bone. Where, however, the deformity is seen before the union is firm, pressure may be so applied as to bend the soft bond of union, and thus obtain a better limb. Formerly, in cases of great deformity with a useless limb, amputation was resorted to; but conservative surgery now first attempts resection or a refracture when possible. The breaking up of recent and deformed callus has so often succeeded in the hands of numerous surgeons that it should be always attempted before other means are resorted to. It is to be accomplished on ordinary mechanical principles.

# CHAPTER III.

## FRACTURES OF THE HEAD AND FACE.

### SECTION I.

#### FRACTURES OF THE CRANIUM.

**Fractures of the Cranium** may be caused by direct force or indirect violence, the "contre-coup" of the French, and the "counter-stroke" of the English surgeons.

As the cranium is an arch, the force creating the fracture must have considerable power; hence the shock is apt to be extended, and result not only in rupture of the fibres of a bone at the abutment of the arch or point of resistance—often distant from the point struck—but also induce laceration of blood-vessels or of the brain, these fractures being complicated with the symptoms of compression and concussion of the brain, as before described in connection with wounds of the head.

**Seat and Etiology.**—Fractures of the cranium may occur at any point, and vary in accordance with the force applied. Thus, when a man is struck with a bludgeon on the top of the cranial arch, the fracture may occur—if the blow be sufficiently violent—at the point where the force is applied; but if the blow is not severe enough to produce a fracture at this point, it may yet create a fracture of the base of the skull in consequence of its force being transmitted along the arch of the skull to its base, where, meeting the resistance offered by the articulation of the occipital bone with the atlas, a fracture results.

Fracture of the base of the skull may also be produced in another way, as when a man falls from a height upon his hips or feet, the force thus communicated to the pelvis being transmitted along the spinal column to the

head, the weight of which gives the resistance, the occipital bone giving way and creating a fracture near its articulation with the atlas.

**Structure of the Cranium.**—To understand the symptoms and treatment of these fractures, it is necessary to study carefully the anatomy of the cranium, a few brief allusions to which will probably be useful to the student in this connection.

The bones of the cranium are composed of two tables of compact matter containing between them a certain variable amount of spongy or cancellated structure or *diploë*, which acts favorably in the case of blows upon the cranium by diminishing their force; hence fractures of thin skulls are more extended than those seen in thick, the thickness of the skull being chiefly due to the diploë.

There are several other structural points which should be borne in mind while studying these fractures; thus, the outer table of the cranial bones is covered by a dense periosteum or *pericranium*, this membrane being thicker along the median line than elsewhere. As it is very vascular, any force which induces a fracture of the bone beneath it may rupture some of its numerous vessels, and create the bloody tumor of the head alluded to under the name of Cephalæmatomata, and which is so likely to cause an error of diagnosis in the examination of cases of supposed fracture of the skull.

The cranium is also lined by the dura mater, so arranged as to form the sinuses or large veins of the head, while between the dura mater and the bone lies the middle artery of the dura mater with its numerous branches, the pia mater or membrane within the dura mater being also exceedingly vascular. Of course any force capable of producing a fracture of the skull will be apt to rupture some of the vessels found in connection with these membranes, and the hemorrhage that results will occasion all the symptoms of compression of the brain before detailed.

Fig. 204.



A representation of an Extravasation of Blood by which the dura mater is separated from the cranium at the ordinary site by rupture of the middle artery of the dura mater. (After Liston.)

The bones of the skull most liable to fractures are those upon its top and sides, next those forming what is properly spoken of as its base, especially the occipital bone; the mastoid process of the temporal and the sphenoidal bone generally escaping.

**Varieties.**—Like other fractures, those of the skull may be simple or compound, besides which they are divided into several varieties, according to the manner in which the bone gives way. Thus a simple crack is designated as a *Fissure*, and is a simple solution of continuity in the fibres of the bone without any other change. This fissure may be combined with wounds and other complications, as may also any other fracture of the skull. When the blow causes a number of fissures radiating from a single point in the shape of a rude star, we have what is known as a *Stellated* fracture. A fracture in which the bone is driven in as well as fractured, is called a *Depressed* fracture. Such fractures require a considerable amount of violence for their production. They may be caused by sabre cuts, by a stroke upon the head with a bludgeon, by a blow with a brickbat, by the kick of a horse or mule, or by falls upon the

head. In some cases these fractures are accompanied by a loss of structure in the cranium, though this is rare and generally due to injuries from great violence; thus it has been known to occur from fractures of the skull caused by the cutting-edge of a circular saw, or by a blow from an axe, cutting out a portion of the bone and leaving the brain exposed.

**Repair in Fractures of the Skull, and Action of the Pericranium.**—The bond of union in fractures of the bones of the skull is fibrous in its character, neither definitive nor ensheathing callus being thrown out; and it is easy to see that, were it otherwise, serious consequences might result from the callus encroaching upon the brain. Recent observations—especially by Ollier in France, and Goldsmith in Kentucky—show, however, that this result depends upon the presence or removal of the pericranium, bony union being reported where this membrane has been left, while simple fissure often heals by bone. This influence of the pericranium will be again alluded to under Trephining.

**Symptoms.**—The symptoms of fractures of the skull vary with the nature of the injury and with the degree of violence producing it. Thus, in all cases there will be more or less contusion or wound of the soft parts, and, if the violence has been sufficiently great, there may be superadded symptoms of concussion of the brain; while if the fragments are driven in so as to create pressure on the brain, or if there is hemorrhage from injury to the arteries of the dura or pia mater, there may be symptoms of compression of the brain.

**Simple Fissure.**—The symptoms of simple fissure are, generally, injury to the soft parts and more or less concussion of the brain, which very often terminates favorably, the fracture generally closing by bone without any deformity, though it at times results in effusion and compression of the brain.

**Treatment.**—In the treatment of a simple fissured fracture of the cranium it should be borne in mind that the chief danger is from concussion of the brain; or that having been passed, from such complications as inflammation of the scalp of the membranes of the brain, or of the brain itself. If concussion occurs it is to be treated in the manner that has been already detailed; but if it is not present, the treatment will consist in the use of such means as are calculated to guard against inflammation. Thus the head should be shaved and surrounded by cloths wet with cold water, while the whole antiphlogistic system should be actively pursued, purging or mercury being resorted to as demanded by the principles already detailed in the general treatment of inflammation. When the fissure or fracture lacerates the middle artery of the dura mater or its branches, symptoms of compression of the brain usually supervene in a few hours.

**Depressed Fractures.**—The symptoms of a depressed fracture of the skull are change in the configuration of the cranium, with the signs of compression of the brain. Frequently the depression can be *felt* by passing the hand carefully over the cranium after the scalp has been thoroughly shaved to free it from its hair. Besides the injury to the soft parts which necessarily accompanies it, this fracture is also usually attended by all the symptoms of compression of the brain, the latter being due either to the immediate pressure of the broken fragments upon the cerebral substance or to the pressure of a clot formed as above explained.

**Diagnosis.**—The diagnosis of a depressed fracture of the skull is of great consequence, as it involves an important question of practice; for, in a case of depressed fracture accompanied with symptoms of compression, it may become necessary to perform the operation of trephining with the view of elevating the depressed fragments. In order, then, to arrive at a diagnosis, the scalp

should be thoroughly shaved and the depression carefully sought for; but it must be borne in mind that every depression felt in the head under these circumstances is not due to a depressed fracture, an effusion of blood beneath the pericranium sometimes assuming such a shape as to give, to the touch, an impression well calculated to deceive. Or the line of a suture is sometimes abnormally depressed, and may be mistaken for a depressed fracture; or an inexperienced observer may mistake for the depression of a fracture the natural depression accompanying those irregular elevations of the cranium to which the phrenologists have applied the term **Bumps.** There is also sometimes a depression around one of the ossa triquetra, which has been mistaken for that of fracture. There is, however, an irregularity about the edge of a depressed fracture which is not simulated by any of the above conditions, and attention to the accompanying symptoms, with moderate delay, will, as a general rule, make the mistake difficult. The degree of depression will vary with the force producing it. Yet it must not be supposed that every depressed fracture involves the brain; the thickness of some crania being such that a considerable depression may exist in its outer table, and yet the brain not be involved. It is only when a depression, which is evidently the result of fracture, is complicated with marked symptoms of compression of the brain, that the operation of trephining is justifiable.*

**Prognosis.**—The prognosis in fractures of the skull will depend upon the degree of the injury. Thus a simple fracture without symptoms of compression in twenty-four hours, and with but a moderate degree of concussion, is less dangerous by far than a depressed fracture; while a depressed fracture accompanied by symptoms of compression is, of course, far more dangerous than one without them.

**Treatment.**—If a depressed fracture is accompanied only by those lighter symptoms which are usually found in connection with simple fissure, the treatment, like that of fissure, will consist merely in rest and antiphlogistics, with a view of preventing any inflammation from being set up in the brain or its membranes.

The treatment of depressed fracture, when combined with symptoms of compression, will consist in the same antiphlogistic measures, and in the performance of the operation of trephining with the view of elevating the depressed fragments and thus relieving the compression, if the views previously expressed in connection with gunshot wounds of the head appear to justify it.

In order to retain a dressing to a fracture of the cranium, either with or without the performance of the operation of trephining, it will be necessary to apply either a T-bandage or the recurrent bandage of the head, as before shown.

## SECTION II.

### FRACTURES OF THE BONES OF THE FACE.

#### § 1.—Fractures of the Nasal Bones.

In order to understand the action of the forces which produce fractures of the nasal bones, as well as the rationale of the symptoms that indicate their existence, attention must be given to the anatomy of the parts concerned.

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* For further details on the cases suited to the operation of trephining, see vol. ii.

**General Relations of the Nasal Bones.**—The nasal bones are placed between the nasal processes of the superior maxillary bones, so that the latter support them on each side.     They have also a direct connection with the nasal process of the os frontis and septum of the nose, as it exists in the ethmoidal bone, and are thus directly connected with the cribriform plate and crista galli of this bone.     A blow upon the nasal bones, therefore, if of sufficient violence, may drive in the nasal protuberance of the os frontis, affect the crista galli, shatter the cribriform plate, and even encroach upon the brain itself, producing concussion, or more rarely compression of the brain, or it may be followed by meningitis.     On each side of the nasal bones are the saccus lachrymalis and ductus ad nasum, which transmit the tears to the nose.     Blows upon the nasal bone of sufficient violence may therefore encroach upon these important passages, and cause such inflammation as will result in their obstruction or in fistula lachrymalis.     The inferior part of the nasal bones are attached to the cartilages of the nose and the cartilaginous septum, while above they articulate with the os frontis, and are covered in by the nasal slip of the occipito-frontalis muscle; the common integument of the face covering all.     Hence these fractures sometimes develop erysipelas of the head and face.     Internally the nasal bones are lined by the nasal or Schneiderian mucous membrane, and hence the epistaxis which generally follows the production of this injury.

The nasal bones are so arranged as to present externally the form of an arch, and as they are small, comparatively thick, and well supported by the nasal processes of the superior maxillary bones, it requires a considerable force to break them.     Besides which, they are so situated that the prominence of the supra-orbitar ridge of the os frontis protects them above from chance blows which, glancing down from the forehead, are more apt to light upon the nasal cartilages than upon the bones themselves.     In order then to produce a fracture of these bones of the nose, the force must be direct.

**Etiology.**—A common cause of fracture in these bones is the blow made by the handle of a windlass, carelessly let go, which, flying round, strikes a by-stander in the face, and readily produces the injury; but any similar force may have the same result, as the blow of a bludgeon, kick of horses and mules, gunshot missiles, etc.

**Symptoms.**—When a fracture of the nasal bones is produced by any of these causes, the symptoms are as follows: There is more or less contusion of the soft parts, with ecchymosis and swelling around one or both eyes. There is also more or less deformity caused by the bones being driven out of their normal line, the degree of this deformity depending upon the amount of violence applied; thus the fracture may be limited to the nasal bones, or extend and implicate the nasal processes of the os frontis and superior maxillary bones.

**Diagnosis.**—The diagnosis of fracture of the nasal bones will sometimes be a matter of difficulty, although at first sight it would appear to be very easy, as the parts swell and become so painful that the patient resists examination, and it is sometimes only when the bones are much depressed that we are able to tell whether they are broken or not.

**Prognosis.**—The prognosis in this fracture, as in all surgical injuries, depends upon the circumstances of the case, the extent of the injury, the nature of the complications, etc.     Deformity of a more or less marked character is very apt to ensue, the line of the nose being often changed from its original shape.

**Treatment.**—The first step in the treatment of this fracture is to bring the fragments into a proper position; a modification of manipulation being required in different cases to effect this object.     If the fragments have been

driven to one side, it is necessary to push them back into line; if they are depressed, they must be elevated; but in either case, when once reduced, they will, as a general rule, retain their position, as there are no muscles of any power acting upon them, and, except from the displacement which might be caused by swelling, or by effusions bound down by dense integuments, etc., there is little danger of the deformity being reproduced.    Still it will often be found difficult to get the fragments back exactly into the ordinary line; and it will be as well for the surgeon, to prevent misunderstanding and disappointment to tell the patient that most probably after this fracture he will not have a nose like the original one.    The fragments may be brought into position by passing a director or small stiff probe into the nostril, keeping it close along the septum narium, pushing it upward and backward so as to elevate the fragments, while, with a finger on the outside, their position may be regulated to the proper degree of convexity.    Then, with a view of guarding against any extension of inflammation to the brain, the patient should be put under a strict antiphlogistic regimen for a few days, and any symptoms which may arise be promptly met.    If there is excess of action, it should be checked by means of leeches, etc., while if from rupture of the blood-vessels of the lining membranes of the nose a troublesome hemorrhage arises, it may be checked by plugging up the nostril with Belocque's canula.*    Having thus met emergencies, and forty-eight hours having elapsed without the appearance of any urgent symptoms, the patient may be considered as pretty well out of danger. Any accompanying wounds of the soft parts of the nose, or of the cartilages, should be dressed by means of adhesive plaster, or if that is objectionable, or if the warm or cold water-dressing is to be applied, the dressing may be retained in position by the double T-bandage, made of broad tapes, and applied as in Fig. 71.    This forms a very excellent means of retaining a dressing to this region, particularly when from too great prominence of the fragments, or from any other cause, it is desirable to exercise pressure upon the nose.

### § 2.—Fracture of the Superior Maxillary Bone.

The shape of this bone, and its position beneath the muscles of the face, are such that it is almost impossible for it to be fractured without wounding the soft parts which cover it.    Generally, therefore, this fracture is the result of great force, though fracture through the alveolar processes sometimes occurs without laceration of the soft parts of the cheek, this being produced by a blow directly upon the front of the teeth.    Such an injury may be created by a blow from the fist of a powerful man, or by any other force acting in a similar manner, and the teeth being thus driven in, more or less injury to the interior of the soft parts of the mouth is produced by their being cut by the teeth, though the exterior structures are only bruised.

**Diagnosis.**—The diagnosis is easy from the deformity and the facility with which the broken bone may be touched.

**Prognosis.**—The prognosis of simple fractures of the upper jaw is favorable.    If the fracture is a compound one, it should be guarded, though probably ultimately favorable.

**Treatment.**—The fracture of the superior maxillary bone, like the fracture of the nasal bone, is to be treated by coaptating the fragments, keeping the patient at rest, and guarding against inflammation and its consequences. As in the case of the nasal bones, if this fracture is once reduced, there is

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* See vol. ii.

but little danger of the displacement being reproduced by muscular violence if the jaw is not used in chewing.

If the teeth have been knocked backward, they should be brought carefully with the finger into their proper position, and kept as perfectly at rest as possible, and if removed by the blow, cautiously replaced. The patient should also abstain from chewing hard articles of food for several months. After coaptating the injured bones, any wounds in the soft parts that may exist will next require treatment, on the general principles already detailed under the head of Wounds of the Face.

## § 3.—Fracture of the Malar Bone.

The existence of fracture of the malar bone as an independent injury has been denied by some good authorities; but there are facts which contradict this assertion, and I have now in my possession two specimens of fracture of this bone of undoubted character, apparently the result of sabre wounds.

**Etiology.**—The fracture of the malar bone may be produced by sabre cuts, by blows from bludgeons, from firemen's spanners, etc.

**Treatment.**—The treatment is to be conducted upon general principles; thus, the fragments of bone should be coaptated as nearly as possible, and the wounds in the soft part, with which the injury is generally attended, be treated like other wounds, cold water-dressings being applied, and any excessive inflammation met by a prompt antiphlogistic treatment.

## § 4.—Fracture of the Inferior Maxilla.

Fractures of the **Lower Jaw** are by far more common than those of the upper, but are comparatively rare, as the lower jaw is so situated and its mobility is such that it yields whenever force is applied to it, a dislocation being much more liable to result from the application of any ordinary violence than a fracture. Even a blow upon the side of the jaw is more apt to produce a dislocation forward of that side than a fracture.

**Seat.**—Fracture of the lower jaw may occur at almost any point; but it is most common in the adult, just anterior to the insertion of the masseter muscle, fracture at or near the symphysis being more frequent in young persons, before the bone has become perfectly ossified at that point. The fracture may be either transverse or oblique.

**Etiology.**—This injury is most likely to be produced by the application of great and sudden force to the jaw, particularly while it is closed. Perhaps the most common cause is a kick from a horse or mule, a blow of a bludgeon, or some similar violence.

The force necessary to produce the fracture is such that the soft parts are often injured, and a compound fracture results, although this is by no means universal. A compound fracture of the jaw may, however, exist without any external wound, the fragments communicating with the cavity of the mouth, such an injury being usually quite troublesome, on account of the action of the saliva washing away the reparative lymph as fast as it forms.

In order to understand the causes producing the deformity which generally accompanies a fracture of the jaw, it is necessary to bear in mind the anatomical relation of the muscles attached to this bone, of which the principal, acting upon the jaw from above, are the masseter and the temporalis, while below we have the insertion of the digastric, the genio-hyoid, and

mylo-hyoid ; and indirectly the sterno-hyoid and sterno-thyroid muscles, which act through the mylo-hyoid by their connection with the os hyoides. The muscles of the mouth and of the front of the neck being thus concerned, it is easy to understand from their origin and insertion how depression and irregularity of the fragments will be produced after the occurrence of a fracture at any point anterior to the angle of the jaw. In fractures of the neck of the jaw-bone or posterior to its angle we shall also note the action of the pterygoid muscles, especially the external pterygoid, the latter sometimes creating sufficient deformity to require to be specially counteracted.

**Symptoms.**—The symptoms of fracture of the lower jaw, independently of the symptoms of the contusion of the soft tissue, necessarily produced by a force so violent as that which usually creates the fracture, are as follows: 1. There is displacement, the level of the jaw being no longer preserved. 2. The U shape of the rim of the teeth is destroyed, as is readily seen on opening the mouth. 3. There is crepitus, pain, loss of motion, and the other ordinary signs of fracture.

**Diagnosis.**—The loss of function, increased mobility, crepitus, and deformity usually render the diagnosis of this fracture easy.

**Prognosis.**—The prognosis of simple fracture of the body of this bone is generally favorable, but the result of a compound fracture is often very tedious, though ultimately favorable. Fracture of the condyles or of the jaw-bone near them is very apt to result in a deformity, that consists in a change in the shape of the angle of this jaw and a marked modification of the original contour of the face.

**Treatment.**—The object of the treatment being to counteract the action of those muscles whose tendency is to draw this bone down toward the sternum, as well as that of the pterygoid muscles by the action of which the posterior fragment may be displaced laterally, the indications are to restore the line of the jaw and draw it up to the upper maxilla, so as to prevent displacement upward or downward, while it is also kept from lateral displacement by counteracting the action of the pterygoid muscle. Any means capable of carrying out these indications may therefore be resorted to.

Fig. 205.
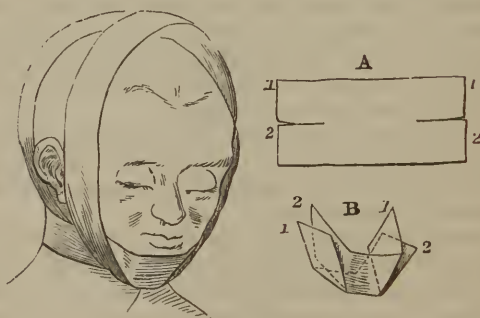


A VIEW OF BARTON'S BANDAGE, WITH THE MOULD APPLICABLE TO THE TREATMENT OF FRACTURE OF THE LOWER JAW.—A. Shape of the piece of gutta-percha for the chin. B. The same moulded to the part—the ends 1, 1, being turned upward, and the sides 2, 2, turned from before backward. The application of Barton's bandage is described in the text. (After Nature.)

One plan of treatment very early employed consisted in wiring together the two teeth next the seat of fracture ; but this is necessarily a very imperfect proceeding, for no matter how firmly the wire is applied, it is impossible to prevent more or less motion of the fragments up and down, and it soon

became apparent that, in order to effect the cure of this fracture without deformity, some more efficient plan must be resorted to; while swelling of the gums usually necessitates the removal of the wire.

A firmer and better dressing consists of a splint made of some soft material, which soon becomes hard, as white of egg and plaster, or the more recent articles of gutta-percha or wet binders' board moulded to fit the jaw, and then retained by a bandage. To make such a splint or mould, take a piece of binders' board of an oblong shape, and cut two slits at each end, so as to extend partly through it; then, after soaking in warm water, apply it to the chin, and fold it up so that the part marked 1, 1, Fig. 205, A, can be carried up the sides of the face, while that marked 2, 2, is turned backward on a line with the base of the jaw, thus making a very excellent cast of the chin. A compress of lint should first be laid upon the chin to prevent the splint from chafing, while over the whole a suitable bandage is to be applied.

**Barton's Bandage.**—A very excellent bandage for this purpose is that of Barton, of Philadelphia, which is to be applied as follows :—

Place one end of a bandage two inches wide and five yards long below the mastoid process of the right side; pass obliquely around the left parietal bone over the top of the head and come down along the side of the face, under the chin; then pass up along the opposite side of the face, over the temple, or between the eye and the ear of this side, across the top of the head and right parietal protuberance to the mastoid process, and thence make a turn circularly around the neck and front of the chin, and from the chin to the neck, which brings the roller back to the point from which it started. These turns being repeated as often as may be considered necessary to give firmness to the dressing, should be fastened by a pin on the top of the head at the point where the turns cross each other, Fig. 205, after which the other points at which the turns of the roller cross may also be secured by pins.

In the treatment of the fracture this bandage should be retained in position for several days without being changed, while during the whole period of the cure the patient should live upon such fluid articles of diet as he can suck through his teeth or can be reduced to a pulp with his tongue. It may be here remarked that the barbarous practice of extracting a tooth in the commencement of the treatment of fracture of the lower jaw, with the view of allowing the patient to suck in liquids through the interspace thus left, is at once cruel and unnecessary, for there are always, even in the most perfect sets of teeth, natural or accidental interspaces which are quite sufficient to answer this purpose.

After three or four days, the bandage should be removed by reversing the turns made in its application; the surgeon being careful while removing it to keep the slack well gathered up in his hand, as otherwise he may, by a careless motion, catch a turn of the bandage on the edge of the chin and do the patient mischief by jarring the fragments, as well as cause him great pain. The bandage having been removed, the splint should be supported by the hand of an assistant, and the surgeon should seize the fragments to hold them in position before the latter is removed, after which the skin over the jaw should be rubbed with a little whisky or soap liniment.

When union has taken place sufficiently to justify the laying aside the bandages and splint, the patient should be cautioned against chewing tough articles of food for some time, in order to allow the bone to obtain its full firmness before it is used.

**Gibson's Bandage** is applied by starting from the point of the chin, and making three circular turns around it and the top of the head, drawing the

lower jaw firmly up against the upper. Then, reversing the bandage at the temporal region of either side, make three

Fig. 206.

circular turns of the forehead and occiput, in order to prevent the first turns from slipping off the face; then, passing down upon the neck, make three circular turns of the chin and neck, after which the same turns may be repeated until the dressing is considered sufficiently firm. To make it still firmer, a strip of bandage may be pinned from the forehead to the occiput, and the turns of the bandage pinned at every point at which they cross, Fig. 206. This forms a good dressing, and one which will fulfill the indications, though liable to become displaced, Barton's bandage being preferable in the majority of instances.

Cases will at times occur—such as certain compound fractures—when the patient cannot bear the pressure of either of the above dressings, or there

Fig. 207.

may be cases in which, from the advanced stage of union, they have become unnecessary, but in which something is yet required to prevent motion in the jaw. Under these circumstances, resort may be had to what is also an excellent bandage, to retain dressings to wounds of the chin—to wit, the four-tailed bandage or *sling of the chin*, as shown in Fig. 85, p. 140.

A modified form of the sling of the chin, made of soft leather and elastic bands, and buckled to bands adapted to the head, Fig. 207, is often employed by the French surgeons in the treatment of this fracture. In fractures of tardy union, or in those badly comminuted, this dressing will prove exceedingly useful, being firm, not easily displaced, and not liable to require frequent application.

Some one of these dressings should be worn by a patient who has a fracture of the lower jaw, for from five to seven weeks, after which they may be discontinued with the precautions above referred to. Various similar bandages have been recommended by other surgeons, but they possess no special advantages, and are trifling modifications of ancient dressings.

As fractures of the neck, condyloid processes, or angle of the jaw, create deformity chiefly by allowing the pterygoideus externus muscle to draw upward, forward, and inward the neck of the bone, while the rest of the jaw is held in position by the attachment of the masseter, thus creating a lateral deformity somewhat like a partial luxation, a special treatment is usually demanded, and may be found in the application of a compress beneath the base and angle of the bone, introducing a finger into the pharynx and pressing the fragment outward and backward, while the crossed bandage of the angle of the jaw, p. 115, Fig. 49, is so arranged as to retain the compress in position. This bandage of the angle of the jaw, if well applied, will be found to be a most useful dressing, being more generally applicable than wiring the teeth. Special difficulties in this fracture may, however, demand special

remedies.   Thus E. J. Fountain, of Davenport, Iowa, reports a case of "fracture of the lower jaw through its body on either side, and also through the neck," on the left side, in which, after having used all the ordinary dressings, he found himself unable to overcome the displacement of the jaw backward and laterally toward the side on which the neck of the jaw had been broken, but was at length successful by the following process :   A hole was drilled through a front incisor in the upper, and another in the lower jaw, that selected in the lower jaw not being precisely opposite that in the right, but the one next on the left hand side.   Through these holes was passed a double strand of fine annealed wires.   The jaw was now drawn firmly forward into its place and retained by twisting the extremities of the strand of wire tightly together.   An ordinary pasteboard splint and four-tailed bandage was then applied.   In four weeks the wires were removed, and perfect union was found to have taken place.*

Ununited fracture of the inferior maxilla is sometimes seen, but depends greatly on the character and position of the fracture.   I have rarely seen it, but Stephen Smith, of Bellevue Hospital, New York, reports† five cases of tardily uniting fracture of the jaw.

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# CHAPTER IV.

## FRACTURES OF THE NECK AND TRUNK.

### SECTION I.

#### FRACTURES OF THE BONES OF THE NECK.

##### § 1.—Fracture of the Os Hyoides.

Fracture of the Os Hyoides is very rare, though it sometimes occurs in consequence of considerable violence applied directly to this bone by some efficient means, such as the grasp of a powerful man, or some cause acting in a similar manner, or a blow directly upon the bone itself.   When broken, it gives rise to a train of exceedingly serious symptoms.

Symptoms.—There is difficulty in deglutition, and a disposition to choke in consequence of the tongue coming back upon the epiglottis; with difficulty in respiration from the fact that the larynx is connected with the hyoid bone.   This fracture is also often complicated with laryngitis, loss of voice, and other serious symptoms due to inflammation of this region.

Diagnosis.—Manipulation will generally render this fracture very evident.

Prognosis.—The prognosis as to the restoration of the voice should be guarded.

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* New York Journal of Medicine, January, 1860.
† Ibid., vol. ii., 3d series, p. 82, 1857.

**Treatment.**—The treatment is to be conducted upon general principles, the fragments being kept in perfect rest, so far as it may be practicable; but little, it must be confessed, can be done in this way, except by means of strips of adhesive plaster. Leeches may be applied, and violent inflammation, should it ensue, be combated by the antiphlogistic treatment which is applicable in all similar cases. If there is such difficulty in swallowing as interferes with the nutrition of the patient, it may be overcome by means of a stomach tube.

### § 2.—Fractures of the Vertebral Column.

**Fractures of the Vertebræ** are comparatively rare, but may be produced by great violence applied to any point in the length of the spinal column, or at the lower limbs, as in falls upon the feet or hips. However created, fractures may occur in the bodies of the vertebræ, in the spinous processes, and in the oblique or transverse processes. The force producing these injuries is generally so great that they are most frequently complicated with injury of the contained organ, the spinal marrow. If any marked displacement should occur, the cavity of the spinal canal will be apt to be encroached on, and symptoms of derangements consequent upon pressure on the spinal marrow invariably result, Fig. 208.

Fig. 208.



A view of a Fractured Spine bisected so as to show how the spinal cord is pressed on by the displaced bone. (After Liston.)

**Symptoms.**—The symptoms of these fractures will, of course, vary, according to the extent and character of the injury, and of the complication of the contained organs.

If, for example, there be a fracture of the oblique processes of the second vertebra, the transverse ligament may be detached; there may be a partial dislocation between the atlas and the dentata; pressure may be made upon the spinal cord at that point, and the patient die instantly in consequence of the interruption of respiration which results. There is no time for treatment in such a case as this, the death being instantaneous.

If the fracture occurs lower down, and is of such a character that pressure is made upon the spinal cord, paralysis of the parts supplied by the nerves given off from the cord below the seat of injury will ensue; and this paralysis is very generally of one side only, (paraplegia,) owing to the pressure being made unequally upon the spinal cord. There being loss of power in the abdominal muscles, with paralysis of the lower extremities of one or both sides, more or less paralysis of the muscular coats of the stomach and bowels, constipation, with paralysis of the muscles of the bladder, as well as retention of urine, are also frequently noticed in this class of fractures.

**Diagnosis.**—Unless freely fractured, the accurate diagnosis of fractures of the vertebræ is almost impossible, owing to the deep muscles, ligaments, etc. that retain the fragments in position.

**Prognosis.**—As the fracture of a vertebra is sometimes limited to a simple fissure, and under these circumstances is difficult to recognize, yet such fractures occasionally recover. Much more serious are those which are accom-

panied by displacement, or by paralysis of the lower extremities; yet, even after such injuries, patients have lived for months, and bony union has in some cases occurred, and the patient been subsequently able to move about.

The prognosis of fractures of the vertebræ, therefore, though very serious, is not invariably fatal. They are, however, as a general rule, followed by more or less paralysis of the lower extremities, which is very apt to be permanent.

**Treatment.**—The treatment of these injuries will be rather that required by inflammation of or injury to the spinal marrow, than by the fracture itself; the latter being inaccessible to direct mechanical agents, except the knife. Though one or two operations have been performed for the removal of depressed portions of the spinous processes, the dangers to life from such a plan of treatment will probably preclude its repetition.

In the examination of the spine of a patient supposed to labor under fracture of the vertebral column, with the view of ascertaining the existence and seat of the fracture, the extent of the injury, etc., the surgeon should carefully avoid turning him upon his face, as serious consequences may thence result; because, as the injury to the vertebral column generally produces more or less injury of the spinal cord, there may be paralysis of the abdominal muscles dependent upon this cause. Hence, if the patient be rolled over upon his belly while the examination is being made, the abdominal muscles no longer by their contraction offer a resistance to the weight of the body, and the cavity of the abdomen is encroached upon, particularly if the patient be a heavy man. The descent of the diaphragm then becomes imperfect, in consequence of the upward pressure of the bowels, and the patient, in his weakened condition, may be almost asphyxiated before the surgeon is aware that he is in danger. In making the examination, therefore, turn the patient simply on his side, when quite as efficient an investigation can be made, and the dangers alluded to entirely removed.

As the patient may be compelled to lie for some time upon his back, even under the most favorable circumstances, everything like blisters or counter-irritants to the spine should be carefully avoided, either in connection with the injury itself, or with the treatment of the spinal meningitis, to which it may give rise. Neglect of this precaution may result in the formation of bed-sores, or cause sloughing, which will very much annoy the patient, give rise to considerable suffering, and seriously complicate the probability of a cure. During the treatment, the patient ought to lie as much as possible on his side, at perfect rest, any complications which may arise, as spinal meningitis, being actively treated by leeches, cups, and purging. As the muscular coat of the bladder participates in the muscular debility consequent on this fracture, this viscus should be carefully watched from the first, and all accumulations of urine prevented by the frequent use of the catheter. The action of the bowels, which is always sluggish in these injuries, should also be watched, and constipation prevented by the free use of laxatives.

## § 3.—Spinal Concussion and Meningitis.

In all cases of spinal fracture, as already remarked, the symptoms of the consequent compression or concussion of the spinal marrow will be much more marked than the symptoms of the fracture itself. In fact, *concussion of the spinal marrow*, like concussion of the brain, is often met with independently of fracture, owing to the jarring of this structure in the spinal canal being much more frequent than fracture itself. Spinal concus-

sion is a common occurrence, in consequence of collisions of opposing trains
and other railway accidents; because when an individual is seated in a car,
with his back resting against the hard back of the seat, and a collision takes
place, the back of the patient is brought violently in contact with the back of
the seat, and concussion of the spinal marrow results.    Many of the sudden
deaths, without any apparent external injury, which have been reported as
having occurred during or after railroad accidents, as well as after amputa-
tions for fractures of the leg from such injuries, may doubtless be attributed
to this cause.

Concussion of the spinal marrow without fracture occurs also from other
causes.    Often it is combined with more or less concussion of the brain.
Thus, a man falling from a height upon his feet or sacrum becomes para-
lyzed, falls back, and, striking his head violently against the ground, receives
also a concussion of the brain.

**Symptoms.**—The symptoms of concussion of the spinal marrow consist in
a loss of innervation in all the parts supplied by its nerves, this loss of in-
nervation in some instances being soon followed by death; thus, the respira-
tion may be feeble, the heart contract with little power, the bowels and
bladder act tardily, etc., while if more marked, it will be followed by such
loss of action in the heart and lungs as will soon terminate in death.    When
*spinal meningitis* is established after a concussion, all the symptoms will
appear which might be expected to accompany the development of meningi-
tis from any other cause; thus there will be pain, fever, paralysis, etc.

The occurrence of spinal meningitis, resulting in effusions often of a limited
character, also explains many of those obscure cases of partial paralysis,
especially in children, which have been so imperfectly understood, or at least
so imperfectly described by writers.

A child sits down upon a damp cold step, and there is, as a consequence,
more or less congestion of the lower part of the spinal cord, or of its mem-
branes; this congestion resulting in inflammation, in effusion, or in thicken-
ing of the cord and its membrane.    This child may suffer little or no pain
in the back at the moment, but after a time will be observed to be stiff in his
movements and to have lost the power, to a greater or less extent, of his
lower limbs, yet have had no fall; and in such a case, as the surgeon can
naturally trace the connection between cause and effect, he should regulate
his treatment accordingly.

**Treatment.**—The treatment of these cases consists in the use of such
means as are calculated to produce absorption of the effusion and the break-
ing down of the plasticity of the lymph.    In one instance of this local paraly-
sis which came to my notice, a married man entirely lost his virility after a
fall upon his sacrum on shipboard.    For the first few days after the accident
he felt no inconvenience, but after a time noticed that his venereal desire had
totally left him, and that he had become almost impotent.    This man, after
being gently salivated and cupped on the spine as well as steadily purged,
recovered his powers entirely, so much so, indeed, that his desires became a
source of annoyance to him.

# SECTION II.

## FRACTURES OF THE BONES OF THE TRUNK.

### § 1.—Fractures of the Ribs.

**Fracture of the Ribs** is a common injury, though not so common as fractures of the bones of the extremities. It may be caused either by direct force at the seat of fracture or by compression of the chest. When created by a direct force, the fracture is generally a transverse one, and presents comparatively little displacement; or, when such does exist, it is due rather to the immediate action of the force producing the injury than to muscular violence. In an oblique fracture from compression of the two extremities of the rib as the consequence of the chest being jammed between two firm points, there may be angular deformity, the points of the fragments presenting forward or backward. This fracture is also very liable to be complicated with a wound of the pleura costalis, or even of the lung itself, or with laceration of the intercostal muscles and injury to the intercostal artery and nerves. As a result of such injuries various morbid conditions may occur, such as pleurisy, or pneumonia, or congestion of the lung, or hemorrhage from the intercostal artery, a small aneurismal tumor being sometimes formed in the course of the artery after the injury; or the inflammation set up at the point of fracture may assume an unhealthy character and result in caries of the rib, or the ensheathing callus may be so in excess as to create inconvenience for many weeks subsequently.

**Symptoms.**—The symptoms of fracture of the ribs consist in such modifications of the ordinary symptoms of fracture as result from the relations of parts. In the first place the functions of the ribs are interfered with, and they are no longer properly elevated, consequently there is not a proper expansion of the cavity of the chest; more or less crepitus, moreover, is to be felt at the seat of fracture, and can sometimes be heard by the patient, though often it is not so distinct. When the patient takes a long breath, it is also apt to be checked by a pricking or more violent pain at a point corresponding with the seat of fracture, this being due either to the sharp fragments irritating the pleura, or to injury of the intercostal nerve. By passing a finger along the course of the ribs the seat of fracture can also very generally be accurately recognized, though deformity is not common. Should the fragments happen to have been driven in so as to wound the lung, emphysema, to a greater or less extent, will usually ensue; but this will seldom be developed to any degree, until from twenty-four to forty-eight hours after the injury, but emphysema may ensue on a wound of the integuments, and fracture without the pleura or lung being punctured. As the consequence of simple fracture of the ribs, emphysema is, I think, a rare complication.

**Diagnosis.**—The history of the case, with the marked symptoms, will usually prevent an error of diagnosis, provided caution is used in the examination.

**Prognosis.**—As in all other cases, the prognosis of fractured ribs will depend upon the nature and extent of the injury, and upon the character of the complications. Thus, if a violent pneumonia ensue, the case will be much more serious than one accompanied by no graver symptom than a slight sticking pain in the side. So the prognosis of a fracture of one or

two ribs, without displacement, will be favorable when compared with a case in which several ribs are broken, and perhaps driven much out of their natural line; and when the injury is accompanied by pleurisy, pneumonia, or emphysema, the prognosis will be much more serious than in the simpler cases. But fractures of the ribs, except when accompanied by violent thoracic inflammation, seldom prove fatal, or require more than four weeks for their cure.

Treatment.—The indications for the treatment of this fracture are to keep the fragments at rest by preventing the rising of the ribs, thus compelling the patient to breathe by his diaphragm, until the bone has united, or at least until sufficient lymph has been thrown out and organized to round off the sharp fragments, and thus obviate injury to the thoracic contents.

On account of the practical difficulties experienced in keeping the ribs at rest, there is generally a proportionably larger amount of callus formed in the union of these bones than in fractures elsewhere, sharp projections of bone, like exostoses, sometimes becoming permanent, and interfering for a long time with the perfect motion of this side of the chest.

As in fracture of the ribs there is no shortening of the bone, owing to the attachment of the intercostal muscles, the main force to be resisted is that of respiration.    In marked respiration the rise and fall of the ribs is very evident, the sternal end especially rising.    Hence, in a fracture, as the sternal end of the anterior fragment rises outward and upward, the posterior end of this fragment will tend inward and backward, or be drawn into the chest in *inspiration* and pushed outward in *expiration*.    To counteract this it is desirable to prevent the marked expansion of the chest, and especially to fix the anterior and posterior ends of the fractured rib.    In some cases it will, therefore, suffice to surround the chest with a towel or to put on a moderately firm and tight-fitting jacket; but in the majority of instances strips of adhesive plaster will be more comfortable as thus applied.    Cut strips of adhesive plaster two inches wide, and as long as half the circumference of the patient's chest, or long enough to reach from the spine to the sternum; then warming them, apply one end over the spine and carry the strip *obliquely* around the chest on the affected side to the sternum, drawing it firmly, commencing two or three ribs above the seat of fracture and coming down below the seat of fracture, each strip overlapping one-third of the preceding strip, and gradually passing more *circularly* around the chest for a few inches below the seat of fracture.    The oblique direction of the upper strips is essential to their proper application; if applied circularly, as generally advised, they will not fit well.    When properly applied, this dressing gives prompt comfort, does not require renewal until evidently loosened, and is in many cases, especially if the patient is confined to bed for the first ten days, the best dressing.    It is not necessary or desirable to carry the strips below the level of the xiphoid cartilage, the compression of the upper ribs sufficing to keep those that are lower at rest. Should emphysema complicate the case, nature will often suffice for its removal; but if very marked, a few punctures in the skin is all that should be attempted, even these being very seldom demanded.

The administration of opiates will check the irritating cough, that is often a source of annoyance, while pleurisy or pneumonia supervening, will demand the usual treatment of these complaints.

## ℨ 2.—Fractures of the Sternum.

**Fractures of the Sternum** are very rarely seen, and when met with are usually the result of great violence. Hence the most serious symptoms are those rather due to the injury and disordered action of the thoracic viscera, than to the fracture itself.

**Seat.**—The sternum is generally fractured at the junction between the first and second bone, because the two lower pieces that composed it originally are attached only to the cartilages of the ribs, which, being elastic, give way under a blow more readily than the upper one does, the latter being firmly supported by its attachments to the clavicles.

**Diagnosis.**—The diagnosis of this fracture is often difficult, unless the force has produced marked deformity or the crepitus on respiration is evident.

**Prognosis.**—The prognosis of a simple case is favorable; though the fracture is liable to leave deformity. When the result of violent compression, the prognosis should be guarded, death often ensuing from the injury of the heart, lungs, and blood-vessels.

**Treatment.**—The treatment of fracture of the sternum is chiefly constitutional, consisting of rest, with the chest elevated and the head depressed, opiates, and careful watching for inflammation in any of the internal organs, the latter being promptly met by an active antiphlogistic treatment; but as the great majority of these accidents are caused by extreme violence, they are often accompanied by complications which result in death. If, after the inflammatory symptoms caused by the injury have subsided, the fragments are observed to play much upon each other during respiration, adhesive strips, with a compress at the fracture, will become necessary, the plaster being applied as in the case of fracture of the ribs.

As a consequence of fracture of the sternum, suppuration may be developed behind the bone, and travel down and open at the side of the ensiform cartilage, so as to point at the insertion of the rectus muscle; or caries of the bone may result, which will present all the symptoms of caries elsewhere, and require to be treated upon the same general principles. Except in caries, trephining the sternum is unnecessary, as pus will usually evacuate itself near the xiphoid cartilage.

# CHAPTER V.

## SECTION I.

### FRACTURES OF THE CLAVICLE.

**Fractures of the Clavicle** are usually regarded as of importance, because they are of frequent occurrence, and result, if not properly treated, in deformity of the shoulders, besides limiting somewhat the subsequent elevation of the arm of the affected side. They may occur at any portion of the length of the bone, as at its sternal third, in its middle, or at its acromial extremity.

T ounderstand the manner in which this injury is produced, it is necessary to bear in mind the function of the clavicle. Situated between the acromion process of the scapula and the end of the sternum, its function is the preservation of the pectoral space. It acts, therefore, as a stay, by keeping the shoulders apart, while it also steadies the motions of the glenoid cavity of the scapula, against which the head of the humerus plays in the motions of the arm.

**Etiology.**—Any direct force may cause fracture of this bone, either at the point to which the force is applied, or—as in counter-stroke—by the application of a force to the humeral extremity, while the other end of the clavicle, by its attachments to the sternum, furnishes the resistance. In the latter case, it is readily seen that if the force be applied to the shoulder, so as to drive this toward the sternum, the force must be transmitted through the clavicle, the sternum resisting it, while the clavicle will be broken at some point between these two forces. When a force is thus applied at one end, while the resistance is at the other, the fracture will generally be oblique; and this is by far the most frequent variety of this injury. When direct violence produces a fracture,—it may be the kick of a heavy gun, the blow of a bludgeon, or any similar cause, which, acting on the body of the clavicle, and not on its ends,—it is apt to occasion a transverse fracture, with contusion of the soft parts around the bone.

In order to understand the deformities which will ensue upon the occurrence of a fracture of the clavicle, the action of the various muscles attached to the bone must be noted. Thus, the sternal end of the clavicle is held in position by the insertion of the sterno-cleido-mastoid muscle, as well as by the ligaments at its articulation with the sternum. The outer fragment, on the contrary, is very movable, being chiefly acted on by the pectoralis major muscle, the contraction of which, by drawing the humerus toward the body, tends, when the clavicle is broken, to draw the shoulder or scapula with it, thus shortening the bone and carrying the humeral end toward the sternum; while at the same time the weight of the arm causes the shoulder, which is no longer supported in the normal manner, to descend, thus creating a prominence of the frag-

ments that can often be recognized at a glance. The shoulder is also now evidently nearer to the body, while the arm is closer to the pectoral space and lower than it ought to be, the forces acting upon it having caused the shoulder to fall downward, forward, and inward, from its normal position. Besides which, if the surgeon's finger be passed along the clavicle it will be readily observed that its continuity is destroyed at the seat of fracture; and when great swelling is not present, one fragment will be felt riding the other.

In consequence of the false position of the shoulder, the action of the humerus is generally more or less imperfect; it has no longer a firm support, and the muscles cannot, therefore, cause it to execute its natural movements, as the arm cannot be elevated or the hand made to touch the opposite shoulder.

**Symptoms.**—The symptoms of fracture of the clavicle are generally easily recognized. Thus the patient, after a fall, or a blow upon the arm or shoulder, feels that he has suddenly lost part of the power of the arm of that side; as the shoulder descends, the weight of the limb becomes painful, and he is disposed to support it by inclining his head and neck to the affected side and by putting the sound hand under the elbow of the injured side, to take the weight of the arm off the shoulder-joint. When a finger is now passed along the clavicle it will also usually be observed that the proper line of this bone in front is destroyed. The mobility of the limb is also very much impaired, especially in raising the hand to the head, placing it toward the back of the neck, practicing circumduction of the arm, or exercising in any manner that will cause the humeral fragment to press on the cervical nerves as they pass out beneath the clavicle. Pain is felt both at the seat of fracture and in the axilla, and the pressure upon the cervical plexus of nerves also causes tingling of the ends of the fingers. In consequence of this pressure, there may also be various complications, some of which are marked, as more or less complete paralysis of the injured arm, or violent hemorrhage, or such an accumulation of blood as will form quite a tumor in the axilla, though these are more or less rarely seen.

**Diagnosis.**—The diagnosis of fracture of the clavicle is usually easily made, provided the patient is seen soon after the occurrence of the injury, as the superficial position of the bone readily shows its condition. But when swelling has taken place, and especially if the force of the injury has also affected the shoulder-joint, it is sometimes very difficult to recognize its existence. By placing a finger close to the sternal end of the clavicle, and having an assistant to force up the shoulder by pressing on the patient's elbow, the fact of the continuity of the clavicle may, however, generally be made apparent, because, if there is no fracture, the sternal end will move when the humeral extremity is elevated, which it will not do when a fracture exists.

**Prognosis.**—The prognosis of the fracture of this bone, as respects the level of the shoulder and the subsequent usefulness of the arm, is generally favorable, if proper means are employed to keep the fragments in position, and union, without the deformity of the level of the shoulders or any apparent shortening, can frequently be obtained by proper attention. The cure of this fracture without deformity has lately been much discussed, but such results have been so often seen in Philadelphia as to leave no doubt on this point in the minds of many, though Hamilton* thinks that "in no other bone except the femur does shortening so uniformly occur." As there is a difference of opinion on this point, the surgeon will do well in this, as in other

* Treatise on Fractures, p. 186.

fractures, not to promise too much, but to remember that Astley Cooper and many able surgeons have obtained cures without any deformity, and strive for the same by attention to the dressings.

**Treatment.**—The principles upon which the treatment of a fractured clavicle is to be conducted, and indeed the only principles upon which the injury can be treated so as to obtain a perfect cure, are those suggested long since by Dessault. In investigating this fracture, this accurate observer recognized the fact that the shortening of the bone was chiefly due to the action of the pectoralis major and subclavius muscles, and proposed, therefore, to overcome it, and obviate the shortening by carrying the shoulder outward, while he overcame the sinking of the shoulder caused by the weight of the arm and other forces, which depressed the humeral end of the clavicle, by so acting under the elbow as to push the shoulder upward. As, by the giving way of the clavicle, the humeral fragment had also been drawn forward as well as inward by the pectoralis muscle, he proposed to carry the shoulder backward in order to restore its line in front. In other words, as the deformity had been produced in consequence of the shoulder being drawn forward, downward, and inward, he proposed the reduction of the fracture by the use of forces calculated to carry it upward, outward, and backward.

In fulfilling these indications, Dessault invented a mode of dressing which is yet frequently used, especially in children. His treatment has, however, been much modified in various hands, and several new dressings have been invented since his day, any of which may be employed, but all of which act upon precisely the three indications suggested by him.

**Apparatus of Dessault.**—This is composed of three single-headed



Fig. 209.

rollers eight yards long and two and a half inches wide; of a pad the length of the humerus, four inches thick at its base, made in the shape of a wedge by folding muslin on itself, so as to form a compress graduated from one end, as before shown, and then covered with a piece of muslin, Fig. 209; of a compress to go over the broken bone; of a short strip or sling to support the forearm; and of a piece of muslin sufficiently long and wide to surround the chest, arm, and bandage, and keep the whole dressing in its place.

These being prepared, the patient should be seated either on a bench or chair without a back, or else standing, an assistant elevating the arm of the injured side, and carrying it off at right angles to the body. The surgeon now puts the pad in the axilla, the thick end upward, where it is to be held by the assistant. The initial end of the first roller being then placed on the middle of the pad, two or three circular turns of the chest should be made in order to fix it, after which the roller should be carried up over the front of the thorax; over the sound shoulder; under this armpit to make a semicircular turn on the front of the chest; over the pad; round on the back; over the sound shoulder; under the armpit, and then spirally around the chest, Fig. 210.

Then flex the forearm on the arm, and bring the latter down along the pad, pressing the elbow moderately against the side of the chest. This, by forcing the head of the humerus outward, draws the clavicle to its original length; for the humerus being thus made a lever of the first kind, its upper end is drawn out from the scapula in proportion as the lower end is forced against the thorax. At the same time the head of the humerus should

be directed upward and backward, as this immediately reduces the fracture, when the assistant should hold it so until the next two bandages are applied— these being intended to keep the fracture reduced. With this view, place
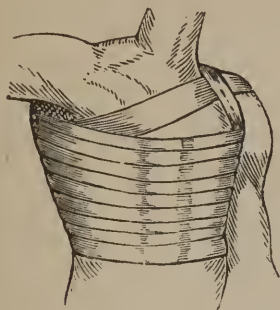
Fig. 210.                          Fig. 211.
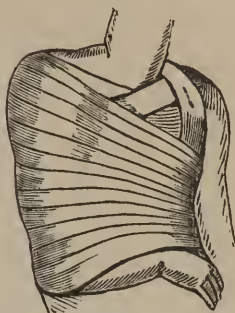
the commencement of the second roller in the axilla of the sound side; carry it across the breast; over the upper part *of the arm* of the injured side, and obliquely round the back to the axilla, whence it started, and continue these turns down the arm to the upper part of the forearm; drawing them gently at first, and gradually tightening them as they approach the elbow, so as to force it well into the side of the body, Fig. 211.

Fig. 212.
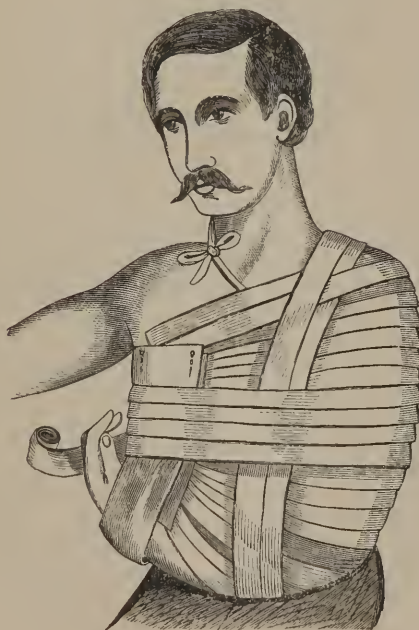
The object of this roller is to carry the shoulder and head of the humerus outward by pressing the elbow inward.

The *third* roller is intended to carry the shoulder and humeral end of the

clavicle upward in order to bring it to the level of the sternal fragment, and to carry it backward to bring the fragments to the same line on the front of the bone.    Commencing at the axilla of the sound side, carry, therefore, this roller over the front of the chest to the broken clavicle; place a soft compress over the seat of the fracture, and, passing the roller over the compress to retain it in position, pass over the top of this shoulder, and down the back of the arm to the elbow; coming under the elbow, pass in front of the chest to the axilla, whence it started; go under this axilla, up the back, over the seat of fracture, down the front of the arm to the elbow, and then from this point of the elbow pass across the back to the sound axilla, and work as before, repeating these turns till the bandage is nearly exhausted. When this bandage is thus applied, two triangles will be formed, one on the anterior and one on the posterior of the chest, Fig. 212.    Then terminate this roller by making a few circular turns of the chest in order to keep the roller at the front of the elbow from slipping off the arm.    To render all firm, support the *hand* by a strip of bandage applied as a sling, and cover them all up with a broad towel or sheet, pinning the whole firmly together, Fig. 213.

Fig. 213.



This dressing is very firm, and answers an admirable purpose in many cases.    It is a capital dressing for children, for lunatics, for those laboring under mania a potu, or others who are likely to require a very firm bandage, as a patient thus enveloped can hardly, by any possibility, move the broken fragments.    But, though firm, and carrying out fully the indications, this dressing is liable to several objections with many patients.

One of these, and by no means the least important, is its warmth, the patient being enveloped in a great number of coverings, as there are over him three rollers, each eight yards long, besides the outer cloth.    This, therefore, constitutes a serious objection to the dressing in warm weather, especially in the case of patients with a delicate skin; as the perspiration readily accumulates, the skin becomes macerated, and is therefore soon disposed to ulceration under the axilla.    Another is, in females, especially those with large breasts, the pressure which it makes upon the mammary gland.    Then, again, inconvenience sometimes of a grave nature will arise from the pressure of the pad in the axilla against the axillary nerves; this having sometimes paralyzed the fingers when the dressing has been tightly applied over a large pad.    These objections, and the fact that the same indications can be carried out by simpler and more comfortable means, induce me to regard some of the other bandages as preferable to Dessault's in the majority of instances.

**Brasdor's Bandage.**—Another dressing is that of Brasdor, which does not carry out the indications, however, as well as that of Dessault, yet answers a good purpose in cases which demand from any reason a very light dressing. It consists of a triangular back piece, which laces down the middle, and to which are attached two padded straps to surround the shoulders, and draw them backward precisely like the posterior 8 of the chest. Of course, in causing the shoulders to move backward, it throws them more or less outward, though by no means so perfectly as is done by Dessault's apparatus. To the above apparatus a sling is added, which fulfills the third indication, by carrying the shoulder upward and backward. This sling may be made of various materials. A very excellent one is that manufactured of gutta-percha, lined with cotton-velvet, and supported by means of a silk band neatly padded, which passes around the neck, though a handkerchief will readily supply its place. Such a dressing answers well when the fracture is complicated with a wound, as in gunshot wounds of the shoulder, a class of cases for which Dessault's apparatus is manifestly unfit.

**Mayor's Handkerchief.**—The handkerchief bandage of Mayor for this injury is a mode of dressing which answers an excellent purpose as a *provisional* dressing ; but it by no means carries out Dessault's indications, though it is well adapted to cases of railroad or stage-coach accidents, or any other emergency where, after the receipt of the injury, it is probable that the patient will have to be moved some distance before a more permanent dressing can be obtained. It is applied as follows :—

Make an extemporaneous pad by properly folding two soft towels, or two large pocket-handkerchiefs, and place it in the axilla precisely like the pad of Dessault. Then fold a large pocket-handkerchief triangularly, and apply it so as to support the arm by enveloping the wrist in its base, bringing its apex around the elbow, and carrying the two points up and round the neck, the one passing under the sound axilla behind the back to the opposite shoulder, and the other going from between the arm and the body over the front of the chest to meet it on the neck. A second handkerchief, folded into a cravat, should then be made to encircle the whole chest, and bind the arm to the side, Fig. 214. Dugas, of Georgia, has suggested* a dressing analogous to this of Mayor, though somewhat firmer.

Fig. 214.
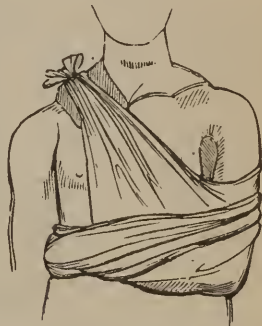


**Fox's Apparatus.**—In 1828, George Fox, of Philadelphia, then Resident Surgeon of the Pennsylvania Hospital, at the suggestion of his friend James A. Washington, introduced into the practice of that institution an apparatus, for the treatment of fracture of the clavicle, that has since gained a large share of professional confidence. Being slightly modified in accordance with the experience of the hospital, it, as at present used, consists of a stuffed collar; a pad about five inches long, four wide, and two or three inches thick at the base; and of an elbow-piece or sling, as shown in Fig. 215.

The collar is made of a piece of muslin four inches wide and long enough to go around the shoulder, sewed together on its sides, stuffed with cotton, and then joined at its ends. The pad is wedge shaped, and like Dessault's, except in its size, being neither so thick nor so long, as it is merely in-

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tended to fill up the space between the upper part of the arm and the side of the body, and yet leave a space between the elbow and the ribs. Two tapes are to be attached to the thick end of the pad, in order to fasten it to the collar. The elbow-piece, or sling, is made of strong muslin or brown holland, like half of the sleeve of a coat, so that it may embrace the elbow, mount half way up the arm, and descend nearly to the wrist. To its upper and posterior ends are attached two pieces of broad tape, long enough to reach across the back to the collar; and on its lower portion are two loops to receive a tape for the front fastening. In applying the apparatus place the collar on the sound shoulder; the pad in the injured axilla; fix it there by carrying its tapes, one in front the other behind the chest, and tie them on the collar. Flex the forearm; place the elbow-piece on it and the arm; bring the arm against the pad by carrying the forearm across
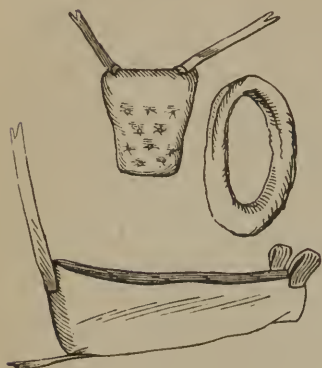
Fig. 215.



Fig. 216.
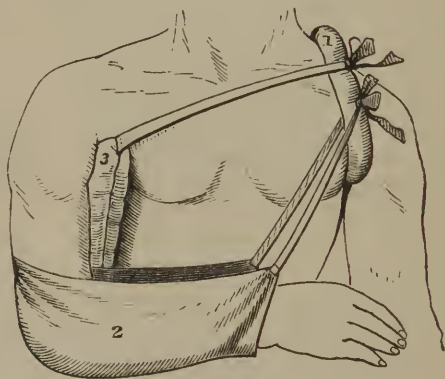


A FRONT VIEW OF FOX'S APPARATUS FOR FRACTURE OF THE CLAVICLE.—1. The stuffed collar applied to the sound shoulder. 2. The sling, as applied to the injured arm. The tapes at the wrist being tied to the collar, draw the elbow into the side and throw the shoulder outward, thus elongating the broken bone. The tapes which are attached to the elbow and upper end of the sling pass across the back and also tie to the collar on the sound shoulder, thus drawing the injured shoulder upward and backward, as shown in Fig. 216. 3. The pad, which is held in the axilla by two tapes, one of which passes across the front, the other across the back of the chest to tie on the collar of the sound shoulder. As the broken clavicle is thus left uncovered, it is easy to recognize the presence of deformity, and overcome it by tightening the proper tape. (After Nature.)

the chest, and tie the loops which are on the sling near the wrist to the front of the collar, as in Fig. 216, when the fracture will generally be found to be perfectly reduced.

Should there, however, be any occasion to carry the shoulder more outward, it may be accomplished by drawing the wrist nearer to the collar; while if it is necessary to carry the shoulder more upward, or backward, draw upon the tapes which are attached to the upper and posterior part of the sling. Next fasten the tape which is attached to the upper and posterior end of the sling to the collar behind, carrying it across the back, so as

to thrust the shoulder upward, and tying that attached to the elbow also to the collar behind the back. The elbow will thus be forced into the side,

Fig. 217.
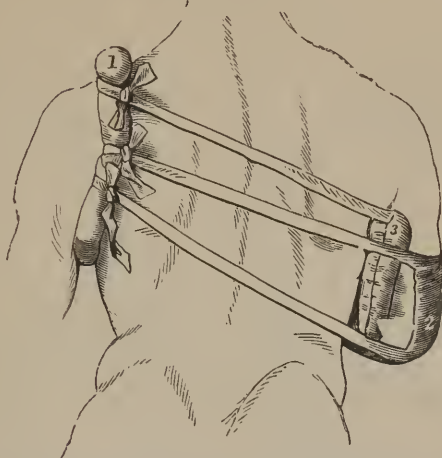


A POSTERIOR VIEW OF FOX'S APPARATUS AS APPLIED, showing the course of the tapes which are attached to the sling at the elbow, and also at its upper posterior end; these tapes traverse the back to the collar on the sound shoulder, and thus carry that of the injured one upward and backward. (After Nature.)

and the shoulder thrust outward and backward to any extent that may be desired. Fig. 217 gives a view of the arrangement of the bands upon the back. The upper strap is attached to the pad; the second one to the superior posterior portion of the sling, and the third to its posterior inferior extremity, or the point of the elbow.

Of all the means recommended for the treatment of fracture of the clavicle few are more simple, or fulfill better the indications, than this apparatus of Dr. Fox. Made in a few minutes of materials nearly always at hand, reducing the fracture, yet leaving it open to inspection, light and easy of application, producing no constriction of the chest, pressure on the mammæ, or on the axillary vessels or nerves, it offers advantages that other means do not generally possess, and its introduction into practice has caused the *cure*, without deformity, of many cases, and saved patients much unnecessary suffering and inconvenience. In Philadelphia it has long been the chief means employed for the treatment of this injury, and the repeated testimony of the many surgery cases has proved its ability to produce perfect cures. From 1829 up to the year 1838, a period of nine years, seventy-five cases of fractured clavicle were treated in the Pennsylvania Hospital; of which sixty-three were discharged cured, and twelve left the house while under treatment, the apparatus allowing of their walking about as usual.* For many years a large number of cases have been treated by myself and others with such success that few who employ it ever resort to any other means of treatment, except in special cases, where an additional bandage, as a posterior 8, etc. may be added. But generally, when there is any derangement of the fracture, it is only necessary to tighten the anterior or posterior tapes of the sling, as above directed, in order to remedy it. When difficulty is experi-

* Wallace's Statistics of Fracture, Med. Examiner for 1838.

enced in keeping the fracture reduced, confinement to bed for two weeks, with the apparatus, will usually overcome it.

Objections have been raised to this apparatus on account of the chafing likely to result from the collar, from the sling, etc., which, however, are equally true of every apparatus by which any amount of pressure is made. Still, these may with care be entirely obviated, and if the surgeon sees that ulceration is likely to occur at any point, he should protect the skin with a piece of soap plaster spread on kid, which will often save it.

**Chisolm's Bandage.** — Another dressing especially applicable to cases where a provisional apparatus is demanded, is the use of the sling of four tails, recently suggested by Chisolm, of South Carolina.* This dressing is simple, efficient, and easily prepared, and is said by him to be readily retained even by children. It is formed as follows: Take a piece of muslin from three to five feet long and from eight to sixteen inches wide, according to the size of the patient, and slit it in the middle of its length, so as to leave from one to two inches untorn in the centre. A soft pad being then placed in the axilla, carry the affected arm across the chest so that the palm of this hand may rest under the opposite axilla; then, placing the centre of the muslin under the elbow, carry the two ends of the superior half, which will cover half the length of the affected humerus, around the body, one strip going under the sound axilla, so as to envelop the hand, and the other passing backward, so as to encircle it, and bind the arm against the pad, the two strips of this half of the muslin being firmly drawn upon and secured with a needle and thread. The inferior half being then under the elbow and forearm as a sling, its ends should be made to pass up in front and behind the chest so as to meet on the sound shoulder, where they should be stitched.

**Apparatus of Levis.**—Another apparatus, which admirably fulfills Dessault's indications, and which for neatness and simplicity is fully equal if not superior to the others, is one to which the attention of the profession has been lately called by Levis, of Philadelphia.†

Fig. 218.
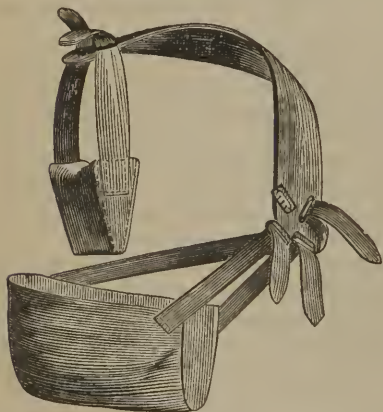


A view of the Pad, Sling, and Collar described in the text. (After Levis.)

"It consists of a short, firm pad in the axilla, by which the shoulder is kept from the side, and over which, as a fulcrum, the elbow is drawn to the side. To the front and back of the axillary pad are fastened straps, which pass directly upward, and are buckled to a wide, main supporting band, which, passing from the shoulder across the upper part of the back, and over the shoulder of the sound side, terminates on the front of the chest, as in Fig. 218.

"By this means the shoulder is supported, and the pad immovably held high in the axilla, where its pressure can be more conveniently borne than when its widest part compresses the brachial nerves and vessels lower down; besides, a better leverage is thus given to the arm over the pad.

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* Charleston Med. Journ., vol. xiii. p. 179, 1858.
† See Am. Jour. Med. Sciences, vol. xxxi., Jan. 1856.

"To the front end of the wide supporting band is suspended a sling, by which the elbow is supported, Fig. 219. On the back of the sling, at a short distance from the point of the elbow, a strap is attached, which passes obliquely around the back, and, coming in front, is buckled to the main supporting band, Fig. 220. The action of this strap is to draw the elbow
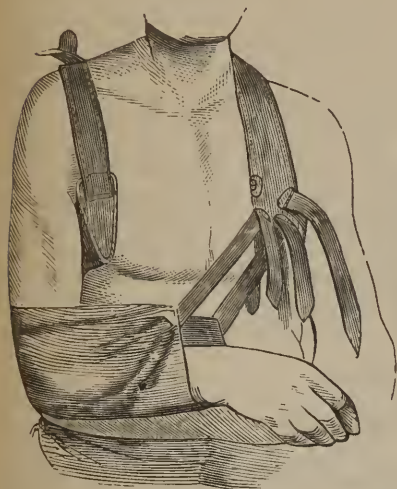
Fig. 219.          Fig. 220.
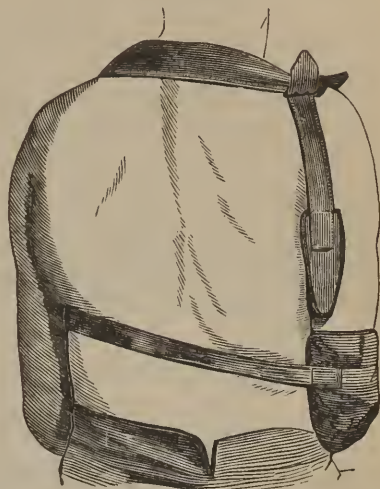


Fig. 219. A front view of the Apparatus, as applied to a Patient. (After Levis.)
Fig. 220. A back view of the Apparatus. (After Levis.)

to the side, at the same time supporting it, while its opposite attachment in front prevents the tendency of the wide band to ride upward and press uncomfortably on the superficial vessels of the neck.

"By this combination, united so as to form one continuous piece, requiring no extra bandage over it, the shoulder is firmly held in the proper direction without any risk of the yielding or slipping of the apparatus, and so secure that the most restless patient cannot disarrange it.

"In adjusting the apparatus, the arm should be passed through the opening above the pad, the wide band thrown across the opposite shoulder, the elbow placed in the sling, and the long strap attached to the back of the sling brought round in front.

"In removing it from the patient, it is only requisite to loosen the long back strap which draws in the elbow, by unbuckling it at its front attachment. The other straps need never be removed from the buckles.

"The extra buckle, which will be noticed at the front end of the wide supporting band, Fig. 219, comes into use when the apparatus is reversed for the opposite shoulder.

"The apparatus may be made of any strong material, as webbing, drilling, or soft leather. The width of the wide band should be from two to four inches. The straps which press upon the surface were slightly padded in the apparatus, as the writer has used it, (Dr. Levis,) but this may not always be essential, and temporary pads might be placed if the pressure should become anywhere uncomfortable. Thus constructed, it can be very speedily prepared at an emergency, and buttons and button-holes might even take the place of buckles."

That difficulties have been experienced in the treatment of fractures of the

clavicle, is well known to every surgeon, and proved by the varied forms of dressing recommended for it, the enumeration of all of which would be tedious and useless, being rather illustrative of the mechanical ingenuity of the inventors than illustrative of any new principle.

When both clavicles are broken, the difficulty in the treatment is much increased. Rare as this accident is, several cases are on record, treated mainly by confinement to bed in the supine position, with pads or pillows in each axilla. But perfect rest under such circumstances is impossible. In a patient who fell into the hold of a ship and broke both clavicles and also his femur, I obtained useful limbs—though with shortening of the clavicles—by the careful application of Fox's apparatus on both arms, the femur being dressed with Physick's splint. When the fracture of both clavicles is near the middle, this form of dressing may be readily applied; and I have seen one other patient able to walk about with this double fracture dressed with Fox's apparatus, and in about five weeks able to go with a simple sling, the deformity and inconvenience being strictly limited to a forward overlapping of the obliquely broken ends of the bones. If the case is a troublesome fracture of the clavicle, and a good cure is desired, the patient should wear the apparatus, and also be confined to bed for two weeks.

## SECTION II.

### FRACTURES OF THE SCAPULA.

When we notice the position of the scapula, the character of the muscles which surround it, and the nature of its connections with the body, it will readily be seen that this bone can very seldom be the seat of fracture, except by the application of a crushing force.

Thus, when a man falls so as to strike the point of his shoulder with considerable violence, the scapula being held on the upper back part of the thorax, chiefly by muscular attachments, yields to the force, and slips back toward the spine, instead of resisting the blow and being fractured, as might be the case if it was a fixed point. Hence it happens that dislocations of the head of the humerus, or of the clavicular articulations of the scapula, or fractures of the head of the humerus are much more common than fractures of the neck of the scapula. Still, there are cases in which the scapula is broken by the application of great violence, as when a man is caught in machinery, or is knocked down and run over by a heavy wagon, or gunshot wounds may create it.

Thus Packard, of Philadelphia,* reports having seen six well-marked cases of fractured scapulæ. One, in a child two and a half years old, from a fall, involved the *neck*, uniting perfectly in two weeks. Another, in a man, near the neck of the bone, relieved in twenty-seven days, when he left the hospital. Another, in a man struck by a crank; this fracture was comminuted, but entirely cured in thirty-two days. Another, of the body of the bone, combined with a fractured clavicle, from a fall into a cellar; cured, with use of the arm, in six weeks. Another, of the lower angle, from a fall down ten stairs, in a woman, that was completely cured in seventeen days. And the last was only discovered after death, in a man who fell from a derrick and broke also the femur and spinous processes of three vertebræ. Three of these cases were injured on the right and three on the left side— the apparatus used in all being merely such as kept the arm at rest.

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* Malgaigne on Fractures, Phila. edit.

Dugas, of Georgia, in a valuable paper on this injury,* also reports four cases of fracture. One, of the body of the bone, from the falling of a ceiling in a high apartment; and another instance, where the body of the scapula was broken by a horse treading on the man, and two by falling trees.

In my cabinet there is a fine example of fracture of the body, parallel to and below the spine, entirely across the scapula, of the history of which I know nothing.

Hamilton† reports one case that he treated, caused by a fall on the back; and one that he saw treated by Neill, in the Pennsylvania Hospital, Philadelphia.

As among 2358 fractures reported at the Hôtel-Dieu by Malgaigne,‡ only four were of the scapula, the accident is apparently more common in the United States than in Europe.

The scapula may be broken at any point, as at the coracoid process, in or below the spine; at its inferior angle; in its body and in its neck. Of these, the fracture of the acromion process is the most frequent, and may be produced by direct violence, or by indirect force transmitted through the head of the humerus.

Fig. 221.



A representation of the Seat of Fracture of the Neck of the Scapula. (After Fergusson.)

**Fractures of the Anatomical Neck** of the bone, except as a result of gunshot wounds, or as complicated with other fractures, are extremely rare, its existence being denied by very many experienced surgeons. There are, I believe, only two in the extensive museum of Dupuytren, in Paris, and these were accompanied by fractures of other portions of the bone, or with dislocation of the head of the humerus;§ but I am not aware of there being any well-authenticated dried specimen of fracture of the neck of the scapula in the United States.

**Fractures of the Surgical Neck**—that is, a line which, commencing at the scapular notch, winds around the bone so as to include the root of the coracoid process and the anatomical neck—are occasionally seen, Sir A. Cooper, Druit, Fergusson, and Dugas reporting cases, and the latter surgeon having specially invited attention to the difference of opinion held respecting the seat of this fracture. I have never seen a satisfactory example of the injury. In a man caught by a band, and swung round and round a drum in a mill, there was crepitus and many signs of this fracture, as detailed by writers, but the swelling and subcutaneous hemorrhage into the axilla prevented me from satisfying myself fully; and as the man recovered and left the city, I never had an opportunity for further study of the case.

**Fracture of the Coracoid Process** is also extremely rare, seldom occurring as a distinct accident, though one is reported as a specimen by Neill, of Philadelphia; one by Gibson, of Richmond; one by Mussey, of Cincinnati; and one case is described by Hamilton,‖ of New York. Union by liga-

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* Remarks on Fractures of the Scapula, by L. A. Dugas, M D. Augusta, Ga., 1857.
† Treatise on Fractures and Dislocations, by F. H. Hamilton, M.D. New York, 1860.
‡ Treatise on Fractures, by Malgaigne, translated by J. H. Packard, M.D. Philadelphia, 1859.
§ See Malgaigne, Traité des Fractures, tome i. p. 498. Paris, 1847.
‖ Hamilton on Fractures.

ment prevailed apparently in all.



Fig. 222.

A representation of the condition of the parts in Fracture of the Coracoid Process of the Scapula, showing the action of the muscles. (After Fergusson.)

When this fracture exists, the deformity is produced by the action of the muscles attached to it, as the coraco-brachialis, pectoralis minor, and short head of the biceps, which draw it out of line, and, by removing the resistance to the forward motion of the head of the humerus, facilitate a partial luxation of this bone.

**Fracture of the Acromion Process** is not so rare; but, from the point at which it occurs, it is doubtful whether some of the specimens of it which have been preserved are not due rather to a failure in the production of ossific union between the epiphysis which constitutes the extremity of the process than to a true fracture, though the latter is sometimes met with; the union between the fragments being generally ligamentous. Two in my possession are evidently separation of the epiphysis.

**Symptoms.**—Fractures of the *body* of the scapula are characterized by "local pain, augmented on pressure, or by coughing, sneezing, or movement of the arm, though passive motion is less painful."* Crepitus is to be felt only by grasping the one fragment, while the other is acted on by moving the arm freely up and down, as well as backward and forward. Displacement is not marked, owing to the close attachment of the subscapularis and other scapular muscles.

In a boy aged six years, struck on the left shoulder by the limb of a falling tree, Dugas, of Georgia, reports† the following symptoms, as seen fifteen days after the accident: "Shoulder drooping and very much flattened; deltoid as though atrophied; supra- and infra-spinatus and pectoralis major also diminished; acromion projecting at a sharp angle, and the head of the humerus depressed about three-fourths of an inch, but easily replaced by pushing up the elbow. The left hand being easily carried on to the right shoulder, while the elbow rested against the thorax, precluded the idea of a luxation. By placing one hand on the shoulder, so as to fix the body of the scapula-acromion process and clavicle, while upward and lateral movements are imparted to the humerus, crepitation can be felt in the shoulder-joint. Crepitation was also caused by grasping the head of the humerus with the ends of the fingers resting on the margin of the glenoid cavity in the axilla, and moving simultaneously the head of the humerus and the glenoid cavity. The coracoid process did not follow the movements of the humerus when elevated and depressed, and the coracoid and acromion moved without crepitus in unison without the lower angle of the scapula, thus showing that a fracture existed at some point between the glenoid cavity and the root of the coracoid process. The boy was unable to move any muscle of the limb, not even of the fingers; the pulse was more feeble than on the opposite side; the sensibility of the skin was obtuse; no degree of pressure on the ulnar nerve gave pain, and there was sudden and marked paralysis." This latter symptom—sudden paralysis—is noted by Dugas‡ as especially peculiar in

* Malgaigne.          † Southern Med. and Surg. Journal, vol. xv. N. S., 1859.
‡ South. Journal, Nov. 1859, p. 745.

this injury, as it was seen by him in three cases, and has not hitherto been alluded to by any writer. I attach to it marked value as a diagnostic sign, as will be apparent when the relation of the nerves and blood-vessels to the neck of the scapula is noted.

Fractures of the *neck* of the scapula give rise to symptoms similar to luxation of the head of the humerus—as flattening of the deltoid muscle; depression under the acromion, though not deep; crepitus, by placing the hand on the top of the shoulder, the forefinger on the coracoid, and rotating the arm; removal of the deformity on pressing up the head of the humerus, and its reappearance when the arm is allowed to hang. In a case reported by Dugas,* the symptoms were as follows: Evident depression of the head of the humerus below the acromion; rotation of its head continuously with its lower end; removal of depression at the shoulders by pressing up the elbow; crepitus very audible and easily felt by placing the hand on the shoulder, while the right moves the elbow up and down; no crepitus when the clavicle, acromion, or body of the scapula were acted on. No pulsation in this case in the arteries; limb insensible below the elbow and partially so above. Pain extreme at first down to the fingers, as well as on the side of the chest; symptoms, especially the latter, being due, as Dugas shows, to injury of the axillary nerves.

When a fracture of the acromion process is produced by any force, such as a fall upon the shoulder, or the blow of a bludgeon, a deformity results, which consists in drooping of the arm and destruction of the proper configuration of the point of the shoulder.

Prognosis.—Although the diagnosis of fractures of the scapula is difficult, especially when seated in the neck, the prognosis is generally favorable.

Treatment.—The principle involved in the treatment of all the seats of the injury is very much the same, being to act upon the elbow in such a manner as to press the arm upward, and bring the head of the humerus in contact with the broken extremity of the scapula, if the fracture is near the glenoid cavity, making moderate pressure from above downward so as to coaptate the fragments; or by holding the arm in the same position so as to keep the scapula at rest, when the fracture is seated in the body, the acromion, or the coracoid processes of the bone; after which no elevation of the humerus should be permitted until union has had time to become firm, owing to the thin, flat character of this bone, and the small amount of callus.

Fractures of the scapula are, however, generally accompanied by so much inflammation from the contusion as to render the removal of this an object of greater importance at first than the treatment of the fracture itself. Warm fomentations by means of bags of chamomile flowers, or flannels wrung out of hot water, leeches, etc., must, therefore, first be employed; after which we may employ the pad, and first and second roller of Dessault, Fox's apparatus, or the bandage of Velpeau. The latter is recommended by its distinguished author as especially applicable to acromio-clavicular luxations; to fractures of the acromion or other points of the scapula; to fractures of the neck of the humerus, as well as to fractures of the clavicle. But from numerous opportunities that I have had of witnessing the result of its application to the latter injury, in his own wards, I think it is not so perfect in its cures as the means before referred to. To fractures of the acromion, neck of the scapula, coracoid, and glenoid cavity it is well adapted, and is applied as follows:—

Velpeau's Bandage.—Make the patient embrace the sound shoulder with

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* Op. citat.

the hand of the injured side, placing a compress or piece of muslin between the side of the chest and the injured arm, in order to prevent excoriation of the two surfaces from contact and perspiration.    Then place the initial extremity of a roller, ten yards long and two and a half inches wide, under or behind the axilla of the sound side; conduct it over the back; over the injured clavicle; down on the front and *outside* of the arm; under the *outside* of the elbow; up and over the chest to the sound axilla.   Make two similar turns, and on again reaching the axilla pass circularly around the chest to the same axilla; then make a turn over the clavicle and arm; then a circular, and so on until the bandage reaches the upper part of the forearm, as seen in Fig. 223. By means of this bandage, especially when wet with starch or dextrine, the arm can be supported in a firm cap, which will last for weeks without changing; but where these articles are not used, several pins must be placed at the different turns, in order to secure them.    It will require but a single application of this bandage to prove its power in the accident referred to; and as dislocations of the humeral extremity of the clavicle are generally admitted to be retained with difficulty in their proper position, this bandage will be found to be a very valuable addition to the other means of treatment.



Fig. 223.

In fractures of the acromion, glenoid cavity, etc., strips of adhesive plaster, carried over the shoulder and under the elbow to hold the head of the humerus up, and press down the acromion, etc., with the addition of one or two strips to surround the chest, and bind the arm and forearm, when flexed, to the chest, will often prove an excellent and all-sufficient dressing. In most cases no pad is desirable in the axilla.

## SECTION III.

### FRACTURES OF THE HUMERUS.

**Fractures of the Humerus** are much more common than the preceding, and may occur in any portion of the bone; thus there may be fractures of its head, these being generally the result of gunshot wounds or of extraordinary violence; fractures of the anatomical neck, which are more common in young persons than in adults, in consequence of the want of close union between the head, which is an epiphysis in early life, and the shaft of the bone; fractures of the tuberosities, and fractures of the surgical neck.   By the *surgical neck* of the humerus is meant the portion of the shaft between the anatomical neck and the insertions of the pectoralis major and latissimus dorsi muscles.    Fractures may also occur in the *shaft*, or that part of the bone above the condyles and below the surgical neck, and through the condyles, either by passing directly through the epitrochlea, so as to involve the articulating surface — the latter exposing the patient to the risk of inflammation of the elbow-joint, and consequent anchylosis — or simply splitting off the projection of the internal or external condyle without involving

the joint; but the fracture through the epitrochlea is, perhaps, that most frequently alluded to as fracture of the condyles.

**Etiology.**—Fractures of the humerus at any point may result from falls, from blows, from violence of any character; or may be due to muscular action.

As fractures of the head and tuberosities of the humerus are rare, and are, as Malgaigne has justly said,* with difficulty distinguished from those of the neck of the bone, if there is little displacement; as they are also amenable to the treatment of fracture of the neck, it is not necessary in a general treatise to consider them in detail.

### ¿ 1.—Fracture of the Surgical Neck of the Humerus.

**Symptoms.**—Fracture of the surgical *neck* of this bone, as before defined, will present a somewhat complicated train of symptoms, the deformity consisting both in angular displacement as well as rotation of the fragments. Thus, in a fracture of the surgical neck or part above the insertion of the pectoralis major and latissimus dorsi, the action of these two large and powerful muscles, with that of the deltoid, will draw the upper end of the lower fragment in toward the axilla, Fig. 224; while the action of the supra-

Fig. 224.
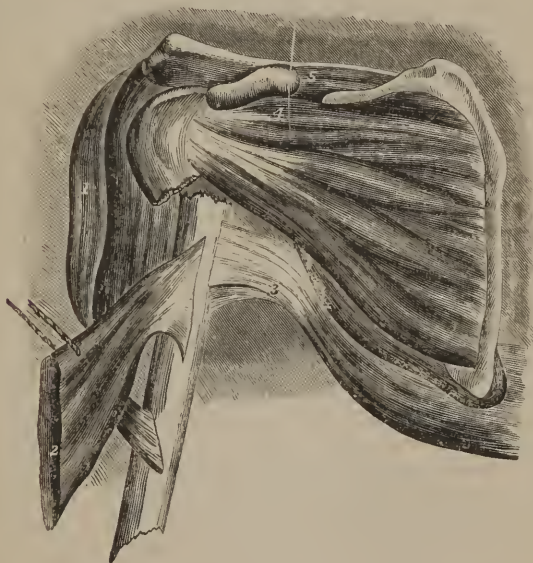


A FRONT VIEW OF THE RELATION OF THE PARTS CONCERNED IN A FRACTURE OF THE SURGICAL NECK OF THE HUMERUS.—1. Deltoid muscle.  2. Pectoralis major dissected off from its origin and turned over the humerus so as to show its insertion.  3. Insertion of the latissimus dorsi muscle.  4. The subscapularis muscle.  5. The supra-spinatus, as seen behind the clavicle.  (After Hines.)

and infra-spinatus muscles, which serve, in the normal condition of parts, to aid in the extreme elevation of the arm, will cant the lower end of the upper fragment outward.

* Phila. edit., p. 25.

In consequence of the action of the deltoid and pectoralis major muscles drawing the upper end of the lower fragment upward and inward, the elbow generally projects somewhat from the side, and the prominence of the lower end of the upper fragment can be distinctly felt, while as the head of the bone still retains its position in the glenoid cavity, there is usually no flattening of the shoulder.

The upper fragment is not only canted out by the action of the supra- and infra-spinatus, but is moreover rotated by the subscapularis and pectoralis minor muscles, so that there is often more or less displacement as regards the circumference of the bones, while the lower fragment is forced up toward the axilla by the contraction of the flexor muscles of the forearm.

The deformity, therefore, in fractures of the surgical neck of the humerus is threefold : first, there is frequently angular displacement ; secondly, displacement as regards the circumference ; and thirdly, more or less shortening, this being due to the action of the deltoid, biceps, and triceps muscles, which, arising from points of the scapula, are inserted directly into the humerus or into the radius and ulna, and thus draw the lower fragment of the humerus up into the axilla.   The danger of shortening in fractures of the neck of the humerus is, however, apt to be overlooked, but it deserves the care of the surgeon, although the shortening of this limb is not so important as it is in fractures of the lower extremities, the difference in the length of the two limbs being less readily perceivable.

In order to prove that the bone has been accurately reduced, its length should be measured, as may be readily done by means of a tape extended from the acromion process of the scapula to the external condyle of the injured side, this being subsequently compared with a similar measurement made upon the sound limb.

In addition to the deformity, which sometimes is and sometimes is not marked, being greatest when the seat of the fracture is at the lowest portion of the neck of the bone, there is usually crepitus, unless the swelling is very great and the fragments impacted, especially when extension is made on the lower fragment, while it is also rotated by using the forearm, bent at a right angle with the arm, as a lever.   When one hand of the surgeon grasps the head of the bone, with the thumb in the axilla and the fingers on the shoulder, and the other grasps the humerus near the seat of fracture, while an assistant moves the elbow and forearm, extension being also kept up by the assistant, crepitus will generally be noted.   The restricted motion of the limb by the patient, the severe pain in the shoulder, the contusion and ecchymosis of the front of the shoulder, or from the insertion of the deltoid upward, all render the symptoms of the existence of this fracture, if seen early, quite marked.

**Diagnosis.**—The complications of fracture and luxation near the shoulder-joint; contusion of the deltoid, and fractures of the scapula; luxation of the tendon of the biceps from its groove, etc., sometimes, however, render the diagnosis of fracture of the neck of the humerus a matter of extreme difficulty, at least until the swelling subsides.   Crepitus may also be produced by the play of the biceps tendon, though easily recognizable from the crepitus of fracture by its less marked character.   Too much caution, therefore, cannot be used in the examination of this injury, comparing its symptoms carefully with those already described in connection with fracture of the scapula, and with those hereafter given as characteristic of luxation of the head of the humerus.

**Prognosis.**—The prognosis in simple fractures of the surgical neck of the humerus is highly favorable as regards union ; but if appropriate treatment be not employed the deformity will be evident, especially in the deviation from the natural roundness of the shoulder and the mode of carrying the arm.

Treatment.—In the treatment of fractures of the surgical neck of the humerus, such forces should be applied as will counteract the action of the muscles that tend to produce the deformity, as before stated. These indications may be answered by a dressing, which consists of three splints and a pad, Fig. 225, the pad resembling that used by Dessault for fracture of

Fig. 225.
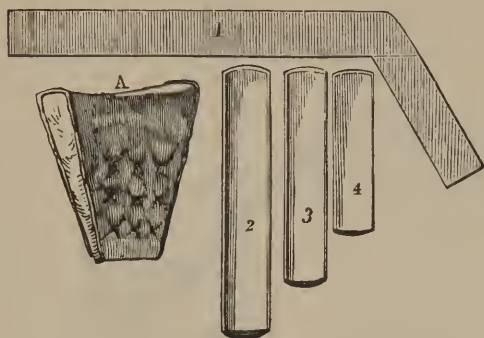


A VIEW OF THE PAD AND THREE SPLINTS required for the treatment of a Fracture of the Surgical Neck of the Humerus, as well as of the angular Splint used with the three shorter Splints in the treatment of Fracture of the *shaft* of the bone.—A. The wedge-shaped pad of Dessault. 1. The angular inside splint. 2, 3, 4. The three splints for the outside, back, and front of the arm in fracture of the surgical neck, the pad acting as a splint for the inner side above. (After Nature.)

the clavicle, and intended to act as an inside splint to the arm as well as a fulcrum to support in its proper line the upper end of the lower fragment. Of the three splints one should be angular, and reach only to the middle of the humerus, on its inner side, so as to keep the elbow at rest, while the three straight splints should be of such a length as would reach from the rotundity of the shoulder to the bend of the elbow, 4, on the outside front and back of the arm, the pad and angular splint acting on the inner side. These straight splints should not be so long as to interfere with the flexing of the forearm upon the arm; may be made of pasteboard, or of light wood carved to suit the convexity of the arm, or of gutta-percha moulded to fit the arm and shoulder, or of wire, or cloths saturated in plaster of Paris and gum-arabic may be moulded to the limb and allowed to harden.

After padding the splints, and before proceeding to apply them, a bandage should be carried from the fingers up to the shoulder, in order to prevent capillary congestion, and the consequent œdema which would otherwise arise from the necessary pressure made about the seat of the fracture, as well as to compress the muscles. This bandage should be the ordinary spiral of the upper extremity.* Then, after applying it carefully, let one assistant keep up extension and counter-extension, while another applies an angular splint on the inside of the forearm and arm, binding it there with spiral turns of a roller as high as the middle of the humerus; then apply the three splints, having first guarded the extremity of each by a little pad of carded cotton to prevent them from exercising undue pressure on the skin. After thus arranging these splints, secure them on the back, front, and outside of the arm by other spiral turns of the same roller. Then, placing the pad in the axilla, with its thick end up, when the lower fragment is drawn inward, and reversing its position if the upper fragment projects inward, omitting the pad entirely if, as is sometimes seen, there is but little

* See page 110.

deviation of the fragments in this direction, bring the arm against the pad which thus forms an inside splint high up in the axilla, and bind the limb to the body by means of circular turns of the roller, carrying each turn around the chest, Fig. 226, and down the arm so as to terminate at the elbow, beneath which none should be made, lest, by pressing the shaft of the humerus upward, shortening of the neck be induced. The dressing should

Fig. 226.
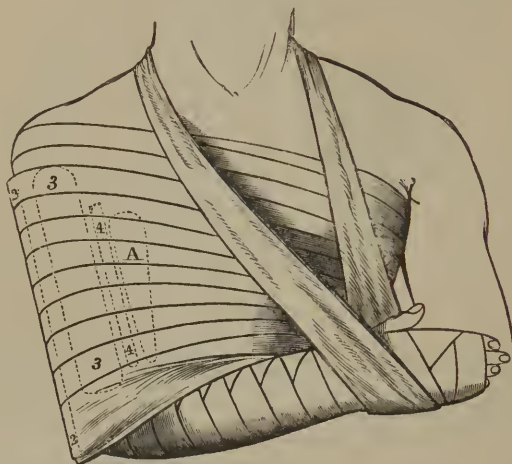


A VIEW OF THE DRESSING FOR FRACTURE OF THE SURGICAL NECK OF THE HUMERUS as applied to the body. The dotted lines show the apparatus inside the turns of the roller which binds the arm to the body. A. The pad in the axilla. 2, 3, 4. The splints in position, as previously seen in Fig. 225. The hand is supported by a sling. (After Nature.)

then be completed by a strip merely to support the wrist, thus allowing the arm to hang, so that its weight may aid in preserving its length, and prevent shortening.

Throughout the treatment care should be taken to avoid false anchylosis of the elbow from confinement in one position, to guard against ulceration of the skin of the axilla and elbow, and to keep the shoulder at perfect rest till the fracture is firm, when passive motion will be useful.

### § 2.—Fracture of the Shaft of the Humerus.

**Fracture of the Shaft of the Humerus,** at any point between the surgical neck and the condyloid epiphysis, is often followed both by angular deformity and shortening of the limb, in consequence of the action of the muscles, especially the biceps and triceps, which, arising from the scapula, are inserted into the radius and ulna, Fig. 227. The forces, therefore, to be resisted are these muscles, while the flexion and extension of the forearm, or any motion of the elbow-joint, must be prevented, owing to its connection with the lower fragment.

**Symptoms.**—The symptoms are those of fractures generally, as pain, deformity, and increased mobility at the seat of fracture, with loss of the proper motions of the arm.

**Diagnosis.**—The increased mobility, crepitus, deformity, and history of the case generally suffice to make the diagnosis of this injury quite easy.

**Prognosis.**—The prognosis is favorable in a simple fracture correctly

treated; but it should be remembered that "false joint" is very frequently met with after fractures of this bone, this result being created either by want of rest, or by the fracture occurring near to the point of entrance of the nutritious artery, or to diseased action.

Fig. 227.

Treatment.—The treatment of fractures of the shaft of the humerus requires four splints, Fig. 228, one of which is angular and long enough to reach from the axilla to the ends of the fingers, being applied to the *front* of the arm and forearm; another (2) of the length of the arm is to be applied to the back of the humerus; (3) one for the outside, and (4) one for the inside of the arm, all of which should be made of light wood and well padded with cotton. Then, while an assistant keeps up extension by drawing on the forearm near the elbow, and counter-extension is made at the shoulder, commence at the wrist and apply the spiral reversed bandage of the upper extremity, continuing its turns up to the shoulder, making several extra turns on the arm at the seat of fracture, so as to compress its muscles with *moderate* firmness. Next, place the angular splint on the front of the arm and forearm, the splint being well padded, especially at the elbow; then, commencing at the wrist, surround the limb with a bandage



A view of a Fracture of the Shaft of the Humerus, showing the action of the Biceps and Triceps Muscles in producing shortening and displacement. (After Hincs.)

Fig. 228.
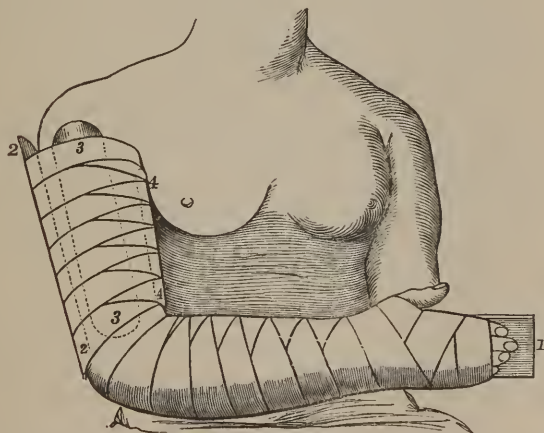


A VIEW OF THE DRESSING APPLIED TO A FRACTURE OF THE SHAFT OF THE HUMERUS.—1. The front angular splint. It should be represented with the palm of the hand turned up to the chin of the patient. 2, 2. The splint on the back of the arm. 3, 3. That on the outside. 4. That on the inside of the arm, the position of the arm across the chest making it appear to be placed toward its inner side, but this is the seat of the angular splint which keeps the elbow at rest. (After Nature.)

as far as the fracture, and bind the arm and forearm to the anterior splint with another roller. Then apply the three short splints, padding them well

at the ends, and, resuming the roller, bind them all to the arm, as in Fig. 228. After which the forearm should be carried across the chest and supported by a sling around the neck.

The advantages of the use of an angular splint—which extends from the finger to the shoulder on the anterior of the arm—over the short splints, advised by Boyer, will be found in the permanency of the dressing, and the perfect rest of the fragments insured by its application.    After employing this dressing for two or three days, it should be taken off and the arm well washed with whisky, when, after ten days, on reapplying it, modify the angle of the splint or substitute another, so as to prevent the stiffness of the elbow which may ensue from the joint being kept constantly in one position.

Various other dressings have been recommended for the treatment of this fracture by different surgeons, but as those stated are simple, easily obtainable, and tested by me for years, I deem them sufficient for ordinary practice.

### ¿ 3.—Fracture of the Condyles of the Humerus.

**Fracture of the Condyles of the Humerus** is a more serious injury, so far as the probability of the perfect motion of the extremity is concerned, than the fracture of the shaft of the bone just described.

As before remarked, the external or internal condyle may be simply split off without involving the joint, but most frequently the fracture of the lower part of the humerus, known as fracture of the condyle, is a fracture directly through the *epitrochlea*, and involving the articulating surface of the bone, changing its relation to the articulating surfaces of the bones of the forearm, while the consequences of the injury are serious, because of the extension of inflammation to the joint. Hence arthritis results, lymph is effused and organized, adhesions form, and the fracture almost always results in an anchylosis, which is more or less complete, and which subsequently prevents the perfect extension and flexion of the forearm that existed prior to the accident, though it will not entirely destroy the use of the joint.

Fig. 229.



A view of the ordinary seat of fracture through the epitrochlea of the humerus. (From a specimen in my cabinet.)

The articulating surface of the bones being thus involved, the condyles no longer retain their ordinary relations, dislocation of both bones of the forearm backward ensuing on the fracture, in consequence of the action of the triceps muscle, this fracture being thus liable to be mistaken for dislocation.    From this, however, it is important to distinguish it, as may be readily done by attention to the circumstances which will be pointed out in connection with the diagnosis.

**Etiology.**—Fracture of the condyles of the humerus is generally seen in young persons or children, and due to the application of a force either directly upon the elbow or indirectly to it through the bones of the forearm.    Thus, it may result from hastily lifting a child by the forearm, or from a fall upon the point of the elbow, in which the olecranon, striking violently against the ground, is driven forward against the condyles, which then give way, and develop the fracture.    Sometimes the bone is broken transversely across, through its articulating surface, creating a separation of the epiphysis from the shaft at this point; or it may be broken by indirect violence, as when the patient falls forward upon

his hands, the force being transmitted along the bones of the forearm to the condyle while the resistance is made by the weight of the shoulder.

**Symptoms.**—The symptoms of this fracture are as follows: After the receipt of an injury upon the elbow, or a fall upon the hand, or after some of the other causes just mentioned, the elbow will be found to be hot, swollen, and often discolored, and the patient will complain of great pain in the neighborhood of the joint, which is increased whenever an attempt is made to flex the forearm upon the arm; the mobility of the joint being always impaired, and, in marked cases, almost completely destroyed, the patient screaming on the least movement of the articulation.

Combined with the above symptoms there is generally more or less deformity, this consisting, in some cases, in complete dislocation of both bones of the forearm backward, or in an increased width of the elbow, or a lateral deviation of the elbow on its radial side, when viewed sideways. Crepitus is also often to be noticed, and a line drawn from one condyle to the other, on the back of the elbow, will fall above or below the extremity of the olecranon process, as stated in the diagnosis.

**Diagnosis.**—A fracture of the condyles of the humerus can readily be diagnosed from dislocation backward of both bones of the forearm, by the fact that the deformity in fracture is very readily reduced by moderate extension and counter-extension, which is not the case in a dislocation; and also by the fact that in a fracture, unlike a dislocation, the deformity is reproduced so soon as the extending and counter-extending force is intermitted. Crepitus and the ordinary symptoms of fracture are also present in fracture, while, if these circumstances are insufficient for a diagnosis, the injury may be recognized by the following rule: If, in health, the forearm be flexed upon the arm, and a circular line drawn around the elbow-joint from the external to the internal condyle, it will touch the point of the olecranon, as well as the two condyles; but if a fracture has occurred which involves either the condyle or the olecranon, these points will no longer be within the line.

**Prognosis.**—The prognosis of fractures of the condyles of the humerus should always be very guarded, compound fractures often demanding amputation, and simple fractures resulting in deformity and partial anchylosis of the elbow, as well as loss of pronation and supination in the hand. The patient should, therefore, always be told that in all probability there will be more or less loss of motion in the joint, as well as imperfect pronation of the hand.

**Treatment.**—In treating fracture of the condyles, it is necessary to overcome the action of the triceps, and thus prevent the dislocation of the bones of the forearm backward, while the joint should be kept at perfect rest in order to reduce the inflammation, passive motion being carefully made, after the first twelve days, to prevent anchylosis.
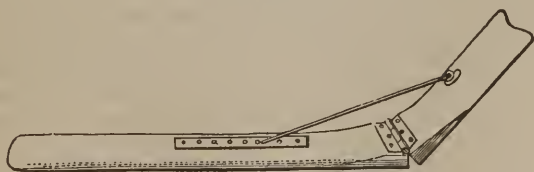
Fig. 230.



These indications can be best carried out by means of an angular splint made to fit the *front* of the arm, and jointed with a hinge at the elbow, so that by means of a wire, properly applied, the splint can be placed at any

angle desired, Fig. 230; or several splints, like those in Fig. 231, 2, 3, 4, may be prepared of different angles. Then having, by extension and coun-ter-extension, with flexion of the forearm on the arm, reduced the fracture and applied the spiral bandage of the upper extremity from the fingers up

Fig. 231.
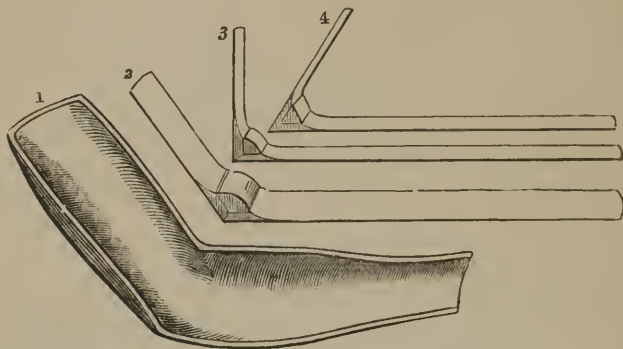


A REPRESENTATION OF THE SPLINTS REQUIRED IN THE TREATMENT OF FRACTURE OF THE CONDYLES OF THE HU-MERUS.—1. The curved splint for compound fractures, or simple fractures when accompanied by much inflam-mation.  2, 3, 4. Angular splints of different angles, to be applied to the front of the arm, as described in the text.  (After Nature.)

to the shoulder, place a wad of cotton in the bend of the elbow, to avoid injury from the pressure of the splint, and fasten the latter to the arm by means of a roller, beginning at the wrist and regularly ascending the arm up to the shoulder.

The pressure made in the bend of the elbow by this splint will certainly prevent dislocation backward, while it obviates the dangers consequent on ulceration of the integuments over the internal condyle, as made by the side angular splint that was formerly placed on the inner side of the arm, in accordance with the suggestion of Physick.  The after-treatment of this injury will often demand such passive motion as will secure the flexion and extension of the forearm, and the pronation and supination of the hand, the change in the direction of the facet of the humerus that articulates with the head of the radius sometimes impairing the function of the latter, while the callus is soft.  This may be remedied by judicious movement.

A compound fracture of the condyles of the humerus sometimes occurs, with accompanying laceration of the soft parts to a considerable extent.  Under these circumstances it would be worse than useless to attempt to apply one of these splints.  The arm should therefore be simply placed upon a pillow in a semiflexed position, while leeches, cold cloths, and other measures proper for the treatment of inflammation of the soft parts are employed; as the injury to the soft tissues, with the consequent inflammation, is here often the most serious part of the accident, the patient being very fortunate if his surgeon is able to save the limb.  When the injury is not quite so extensive, and is so situated in regard to the joint as to permit it, advantage will be found from the use of the carved splint, 1 of Fig. 231, or one of pasteboard or gutta-percha, either simple or supported on the outside by strips of tin.  In em-ploying the carved splint, the arm may be laid within it, and supported by the bandage of Scultet; but if the splint be properly applied, this bandage may be laid aside, as the limb can be raised and the wound dressed daily when a few turns of the ordinary spiral roller are loosely applied around it, without deranging the fragments, or removing the arm from the splint.

Of the splints required in compound fractures of the condyles, or for the first few days after the occurrence of simple fracture accompanied by inflammation and swelling of the elbow, that carved out of wood is infinitely preferable, and may be readily made by the following process :—

Having selected a piece of soft poplar or white pine about two inches thick, lay the injured arm upon it, and mark its outline with a lead-pencil, tracing accurately its angles, prominences, etc. by running the pencil over them; then, with a penknife, if nothing better can be obtained, or with a gouge, hollow out the wood so as to make it correspond with the shape of the arm. Having thus worked it out in such a manner as to fit the arm as nearly as possible, shave down the outside so as to leave the splint as light and thin as would be consistent with firmness, after which a piece of buckskin may be glued over the inside to protect the skin, and a piece of muslin or linen placed on the outside to prevent the thin wood from splitting or warping. Of course, if a finished article is required, it must be procured from a carver; but a splint like the above, which will answer a very good purpose, can be made under the direction of the surgeon by any workman.    Tin-wire, felt, plaster of Paris, and cloths, or gutta-percha will also answer the same purpose.

## SECTION IV.

### FRACTURES OF THE FOREARM.

#### ₰ 1.—Fractures of both Bones of the Forearm.

The **Bones of the Forearm** may be broken at any point in their length, but most frequently the injury will be found at some point below the upper third, and in one bone, especially the radius, rather than both.    The reason why the upper third of either of these bones is so seldom broken is to be found in the protection afforded them by the bellies of the muscles of the forearm, which so envelop them that a simple fracture at this point is of rare occurrence.

**Etiology.**—The causes of fractures of the forearm are blows, falls in which the weight of the body is caught upon the hands, or in which the arm is caught under the body, under a carriage wheel, in machinery, etc.

When a fracture of both bones occurs, it happens, as a general rule, at one point in the radius and at another in the ulna, particularly if the injury has been caused by a fall upon the hands.    Still, cases occur in which a fracture of both of these bones is found at the same point, as when the arm is thrown up to fend off a blow.    Such fractures may also be caused by catching the hand or forearm in a wheel, etc.

Besides fractures of both bones, either the radius or the ulna alone may be broken at any point in their length without a fracture of the other bone. Most frequently the radius alone is broken; next in frequency comes the fracture of both bones, and the least frequently seen is the fracture of the ulna alone.    When one bone only is broken there will be but little shortening, the sound bone acting as a splint, and preserving tolerably the normal length of the arm.    Indeed, there is seldom much shortening in fractures of the forearm, even where both bones are broken, in consequence of the character of the muscular attachments of the part, and of the interosseous ligament, the displacement being rather a deformity in the thickness of the bone or angularity, with more or less displacement in the circumference or rotation of one fragment on the other, caused by the action of the pronator or

supinator muscles, Fig. 232, connected with the motions of the wrist and hand. Whether a fracture affect both bones or but one, the symptoms and the treatment are very similar, except in the special fractures hereafter mentioned.

Fig. 232.



A VIEW OF THE MUSCLES OF THE FOREARM AS CONNECTED WITH THE DEFORMITY CREATED BY A FRACTURE OF THE SHAFT OF THE RADIUS.—1. Biceps flexor cubiti. 2. Pronator radii longus. 3. Pronator radii teres. 4. Pronator quadratus. (After Hines.)

**Symptoms.**—The symptoms in either case will be pain, swelling, inability to execute the functions of the forearm, more or less contusion of the soft parts, and consequent infiltration of the cellular tissue with blood.

These general symptoms will be found without much change in all fractures of the bones of the forearm, whether the radius, ulna, or both bones be involved.

Sometimes in the young there is a disposition toward partial fracture, combined with bent bones, of which there are two specimens in the Wistar and Horner Museum of the University of Pennsylvania,* Fig. 233,

Fig. 233.



A representation of a partial Fracture of the Radius in a young patient, accompanied with the bending of the fragments. (After Fergusson.)

but the symptoms are then complicated with the ordinary symptoms of bent bones, and the deformity which results would hardly be mistaken for that of fracture.

**Diagnosis.**—Palpation, pronation, and supination of the hand, while the elbow is held firmly, together with the pain, crepitus, and deformity, generally render the diagnosis of this fracture easy.

**Prognosis.**—The prognosis of a perfect cure should be guarded, though such a cure is often obtained.

**Treatment.**—The object of the treatment is to keep up extension and counter-extension sufficient to retain the fragments in position, while by pressure we prevent such angular deformity as might encroach upon the interosseous space, as it will readily be understood that if there is an angular displacement in either bone so as to encroach upon this space, it will interfere with the free pronation and supination of the hand. A very moderate amount of extension and counter-extension usually suffices to effect this object, and it may be accomplished by seizing the patient's hand with one hand, and his elbow with the other, and then drawing with sufficient force until the fragments are brought into the proper line. The surgeon, then giving the limb in charge of an assistant, should coaptate the fragments, carefully observing that the interosseous

* At Philadelphia.

space is preserved. The importance of this latter point in the treatment of fractures of the forearm cannot be over-estimated; as, even if the deformity in the bones themselves does not interfere with the pronation and supination of the hand, it should be borne in mind that the ensheathing callus which is thrown out will extend beyond the bones, and thus limit their motions; hence this fracture should be kept at perfect rest, not only because motion is liable to displace the fragments, but because the quantity of ensheathing callus is liable to be increased by the frequent action of the part.

The dressing best adapted for the treatment of fracture of both bones of the forearm is as follows: The forearm should be semiflexed upon the arm, the thumb pointing upward, and two splints, carefully padded, be placed one upon the front and the other upon the back of the arm, these splints being padded so as to make pressure on the interosseous space, and preserve the parallelism of the bones. Then, while they are held in position, fasten them to the forearm by a roller, beginning at the wrist and moving up to the elbow.

Fig. 234.
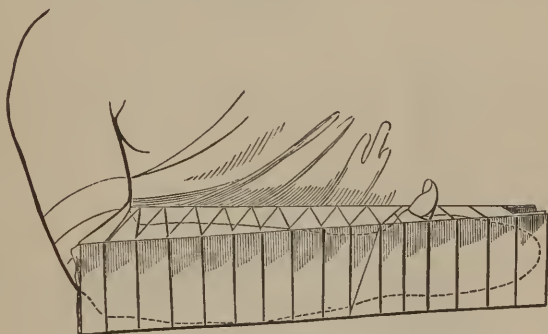


A view of the Splints, etc., as applied in the treatment of a Fracture of one or both bones of the Forearm. (After Nature.)

A very simple fact will at once point out to the surgeon whether the parallelism of these bones has been preserved. If, after applying the dressing, the thumb points upward when the forearm is semiflexed upon the arm and carried across the chest, as in Fig. 234, it may be taken for granted that the fragments are properly in position.

The dressing as thus applied should be supported by a sling, and changed from time to time—say every two days—stimulating frictions being applied to the skin when the splints are removed, in order to prevent chafing. Sometimes patients will require to be carefully watched to prevent them from making improper movements with the splints, particularly in the case of children, who are often disposed to use the ends of the splints in various ways, thus causing displacement of the fracture as well as of the dressing.

## § 2.—Fracture of the Radius.

A simple fracture of the **Shaft of the Radius** or **Ulna** presents all the symptoms, and requires precisely the same treatment, as fractures of both bones of the forearm. The deformity in this case does not, however, consist in shortening—as the ulna, being uninjured, continues to preserve the length of the forearm—but rather results in angular deformity and an approximation of

the two bones at the seat of fracture, with a loss of power in pronating or supinating the hand, from the action of the pronator or supinator muscles, as shown in Fig. 232.

There are also fractures connected with the lower third of this bone which are frequently met with, and require special consideration in consequence of their effect on these motions of the hand and wrist. These fractures of the **lower extremity of the radius**, although of frequent occurrence, are perhaps oftener overlooked than any other accident in surgery, owing to their being often mistaken for sprains of the wrist, or from the patient not being seen by the surgeon until the swelling has gone to such an extent as to obscure the injury.

A very little attention to the mechanism of the wrist-joint will show at once why a fracture of this portion of the radius is more common than fracture of the ulna. The radius, articulating with two of the bones of the carpus—the scaphoides and lunare—receives, when a patient falls upon the hand, the greater part of the force, the elbow-joint acting as a resistance, Fig. 235. Hence, when the radius sustains the weight of the body in a fall

Fig. 235.
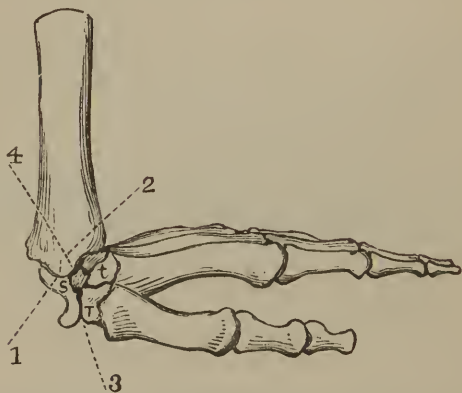


A DIAGRAM SHOWING HOW THE FORCE IS TRANSMITTED TO THE RADIUS IN FALLS ON THE HEEL OF THE HAND.— 1, 2. Line of fracture on posterior margin of radius. 3, 4. Line involving styloid process. Any inclination to one side or the other in a fall will cause a variation in the line of the force.

on the hand, the bone gives way just above the wrist, this part being in reality its weakest point, although the radius is here much thicker than above, its extra development at this point consisting, however, principally of cancellated structure; neither has it the cylindrical shape which gives strength to bone. In addition to which, the articulating surface is an epiphysis, not fused to the diaphysis until full adult life, and then liable to yield at the line of fusion.

**Barton's Fracture.**—Two distinct fractures are often met with at this end of the radius—one oblique, the other transverse—both of which extend through the articulation, the transverse one chipping off the posterior articular edge, the line of fracture extending obliquely and perpendicularly up the shaft till it ends three-quarters of an inch above the joint; the other splitting off also, or alone the portion connected with the styloid process. As this injury was originally described by Rhea Barton, of Philadelphia,* it is known in the United States as *Barton's fracture.* As its true seat is often misunderstood, I shall now refer to it in detail.

**Mechanism and Seat.**—When from a fall, or any similarly applied violence, this accident occurs, the force is transmitted, as shown in Fig. 235; and the continuity of the epiphysis with the shaft being thus destroyed, the action of the extensors of the thumb and of the flexors of the fingers at once produces a deformity on the *front* of the wrist, which is so marked that it is not unfrequently mistaken for dislocation of the extremity of the radius forward. At the same time, the fibres of the capsular and lateral ligament of the wrist giving way, I have no doubt, from the specimens that I have seen, that in some few cases there is also a fracture of the styloid process of the ulna, just as fractures of the fibula above the ankle-joint are sometimes accompanied by fractures of the internal malleolus. This latter complication is well illustrated by a specimen now in my cabinet, shown in Fig. 236.

Fig. 236.
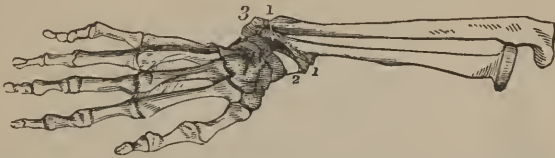


A REPRESENTATION OF THE OBLIQUE FRACTURE OF THE LOWER ARTICULATING SURFACE OF THE RADIUS KNOWN AS "BARTON'S FRACTURE."—1, 1. The seat of fracture on the styloid side of the radius. 2. The external lateral ligament of the wrist-joint on the stretch, from being dried. 3. Fracture of styloid process of the ulna, which existed in this specimen. (After Nature.)

But, as a general rule also, as far as my observation goes, a fracture of the styloid process of the ulna is rare in this injury. The thickness of the articular margin and shaft that is split off from the main portion of the bone depends mainly on the degree of extension of the hand at the moment of falling on it, the uneven character of the surface on which the heel of the hand rests, and the tendency in the body of the patient to tilt over the arm or fall on the head.

Fig 237.



The dorsal edge of the articular face of the radius being in such a fall pressed on the posterior face of the second row of the carpal bones, the convex surfaces of the scaphoides and lunare are forced directly upward and backward in the line 1, Fig. 237. In this action little or no weight is borne by the front surface of the radius, but the flexor tendons, as they play through the anterior carpal bursa, are stretched; the bursa inflames and swells, and the effusion, being firmly bounded by periosteum and bursa, creates a tumefaction that feels precisely like bone; hence the appearance of fracture on the front of the radius. In the varied application of the force brought to bear on the radius in this injury we find different lines of yielding, all starting from the articulating surface and running upward, viz.:—

A DIAGRAM SHOWING THE UPPER LINE OF THE FRACTURE OF THE RADIUS IN BARTON'S FRACTURE.—1. Upper end of the fissure that commences in the articulation. 2. Portion broken. 3. Scaphoides. 4. Lunare. These bones transmit the force to the radius, and thus act like wedges in inducing the fracture.

1. A transverse fracture of the posterior half or two-thirds of the articular

face of the radius, thus displacing the grooved margin in which the extensor tendons play.

2. A split of the radius directly upward through its articulating facets for the scaphoides and lunare, this being often combined with the first.

3. A split of the styloid process and that part of the articulating face of the radius that corresponds with the convexity of the scaphoides alone— thus separating the styloid process and the corresponding margin of the radius as high as a half inch or more up the bone—from the shaft and remaining portion of the articulating face. Of these varieties there are twelve specimens in the museum of the New York City Hospital, and several others that I have seen elsewhere. Owing to the close attachment of the capsular ligament and periosteum, the line of separation in this variety of fracture is restricted; but as the resistance to the action of the extensors of the thumb is here removed, the tendency to a lateral luxation and also to a fracture of the styloid process of the ulna is here increased, Figs. 237, 238.

Fig. 238.



A LATERAL VIEW OF THE FRACTURE OF THE POSTERIOR MARGIN OF THE ARTICULAR FACE OF THE RADIUS IN BARTON'S FRACTURE.— 1. Styloid process. 2. Margin of fracture.

As this fracture was originally described by Barton in a manner that gave it but little publicity, it is often imperfectly understood, and confounded with the descriptions, by European surgeons, of fractures near the wrist, as that of Dupuytren, Colles, Cooper, and Smith of Dublin—Dupuytren making the fracture three to six lines from the articulation, Cooper an inch above it, etc.—as is evident from the remarks of these writers on this injury. Then the close attachment of the periosteum, bursa, tendons, and fascia around the joint is such as to create the most deceptive sensations of the line in which the bone has yielded. When the periosteum is elevated by effusions, as in nodes, abscesses, etc., it feels precisely like bone; and as its attachment, about one inch above the articulating margin of the radius, is close, this line gives the positive sensation of being the actual seat of fracture, while it is only the terminal line of a fracture that commenced within the articulation. Hence Barton's fracture is often confounded in England and the United States with Colles's fracture, from which it differs materially in seat, deformity, and result, as will be subsequently shown.

Figs. 239, 240, show the condition of the bones, when cleaned from periosteum, etc., in Barton's fracture.

Recognizing, as I have done by post-mortem study, the true seat of the fracture that Barton described from the living man, the action of the forces creating the deformity may be readily shown :—

1. The deformity consists, as stated by Barton, in a subluxation of the radius upon the carpal bones, with a lateral deviation of the hand to the radial side of the forearm.

2. The deformity may be caused by the force of the fall being transmitted through the carpal rows of bones.

3. By the action of the extensor muscles of the fingers, which, acting on the metacarpus, force up the carpus, and through it the posterior articulating margin of the radius.

4. By the extensor prop pollicis and ossis metacarpi, which, as shown by the dotted lines, Fig. 241, pressing the thumb through its metacarpal bone

Fig. 239.          Fig. 240.
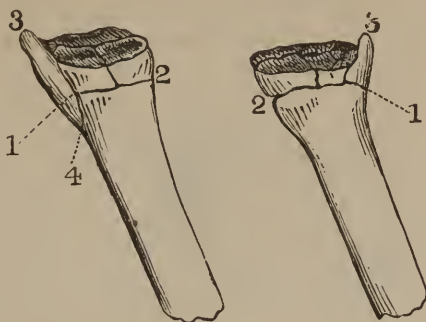


Illustrations of the Line of Fracture, as obtained from a recent specimen, within forty-eight hours after the fracture, the patient dying of other injuries. (After Nature.)

against the trapezium and scaphoides, and these against the corresponding articular facets of the radius.

Fig. 241.
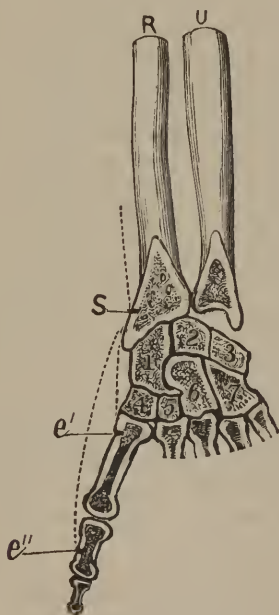


A DIAGRAM SHOWING HOW THE EXTENSORS OF THE THUMB PRODUCE THE LATERAL DISPLACEMENT IN BARTON'S FRACTURE.—S. Styloid process. e', e''. Insertions of tendons.

As the fracture thus detailed removes the natural resistance to the action of the muscles just mentioned, the fragment must slide upward and backward, especially on the radial margin of the arm, thus creating a deformity in accordance with the length and thickness of the bone, and developing the subluxation described by Barton.

**Symptoms.**—The symptoms produced by this accident are as follows:

The patient complains of pain in the wrist, which is very marked in its character, though often regarded as due to a sprain, and, upon examination, a fullness is observed on the front of the wrist, looking not unlike a swelling of the bursa of the tendons, while on the back of the hand there is but little deformity, more or less *lateral* displacement being always present, particularly if the styloid process of the ulna is broken in the manner above described, Fig. 242.

Fig. 242.
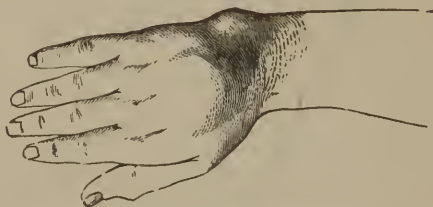


A representation of the deformity caused by Barton's Fracture, showing its resemblance to a lateral and anterior dislocation.   (After a cast from Nature.)

**Diagnosis.**—If, under these circumstances, the surgeon places a finger upon the head of the radius and pronates and supinates the *wrist*, the patient will not suffer greatly, and the head of the radius will be observed to rotate under his finger, because the attachments of the carpel, as well as of the interosseous ligaments, prevent such a separation of the fragments as would enable the lower fragment to be moved independently of the wrist.   In consequence of this apparent continuity, an inexperienced surgeon is apt to be deceived and be led to suppose that no fracture existed.   But if, observing the facts just stated, he puts his finger upon the head of the radius, and then, *seizing the styloid process* of this bone and its carpal articular face with the fingers of the other hand, rotates it gently, the head of the bone will be observed to remain stationary, while the fragment below will rotate, and create such violent pain that the diagnosis can be at once made.

With regard to the diagnosis of this injury from luxation of the radius forward, a few words may be said.   Barton's fracture is an accident of comparatively frequent occurrence, luxation of the radius rare, though the two may exist at the same time.

The following facts will aid in the diagnosis of those doubtful cases which are occasionally met with :—

If extension and counter-extension be employed with firm dorsal pressure above the line of the carpus, the deformity in this fracture will disappear just as that of a luxation might be expected to do ; but as soon as these forces cease to act, the deformity will be reproduced in the fracture by the action of the extensors of the hand and fingers, which will not be the case in simple dislocations.

Besides this, the force sufficient to overcome the deformity in Barton's fracture is much less than that which would be necessary to overcome the deformity consequent upon a simple dislocation.

**Colles's Fracture.**—In addition to Barton's, there is another fracture of the lower part of the radius, which was first noticed by Colles, of Dublin, in the year 1814.   He described it as occurring at a point about *an inch and a half* above the wrist-joint, not involving the articulation, and therefore differing in this respect from that of Barton.   *Colles's fracture*, as it is now designated by European writers, produces a deformity which approaches in character to that of Barton, though not precisely similar.   In

both there is lateral displacement, this being most marked in Barton's; but, in Colles's fracture, the fullness on the *front* of the wrist is not so marked as in Barton's, while that upon the *back* of the hand is much more so.

A fracture producing the same deformity as that attributed by Colles to the fracture which bears his name, has been more recently, and more accurately, described by Smith, of Dublin, as a fracture of the radius *three-quarters of an inch* above the articulating surface, thus also differing from Barton's fracture in not invariably entering the articulation and affecting the joint. The deformity produced by this injury upon the back of the hand is quite a peculiar one, and has been graphically described by Velpeau as the "*fork-like*" deformity, in consequence of the general resemblance to the shape of the ordinary silver fork presented by the back of the wrist and hand in these cases—a comparison which, however, does not apply to cases of Barton's fracture. In the work of Smith, of Dublin, "On Certain Fractures as yet not Accurately Described," several cases of Colles's fracture will be found detailed and accompanied by drawings.* I cannot but think, however, that such a fracture as is described by Colles and Smith is much more rare than the fracture involving the articulation, and known in the United States as that of Barton. Yet all these fractures somewhat resemble each other, and may be confounded: thus, all are fractures of the lower part of the radius; all create deformity about the wrist; all impair the motion of the joint; but the principal difference between them is to be found in the fact that one (Barton's) passes into the articulation, while the others (Colles's and Smith's) do not; that the pronator quadratus muscle is involved in the injury described by Colles and Smith, but not in Barton's fracture. Owing to the proximity of the wrist-joint all these injuries will, however, if not well reduced, materially impair the motions of flexion of the wrist, as well as pronation and supination of the hand. Barton's will also create marked lateral deformity. Barton's fracture predisposes to a subluxation of the hand, externally and laterally; Colles's to one of the carpus anteriorly. Colles's creates the curve on the back of the hand that Velpeau has described as that of the "silver fork," and both cause swelling of the anterior carpal bursa. When there is marked *lateral* deviation, the fracture will probably be Barton's, and must be remedied by counteracting the action of the thumb extensors.

Diagnosis.—The diagnosis of this fracture, and of course its proper treatment, requires close attention to the rules and explanations above given. Many surgeons have doubtless, like myself, been misled by ante-mortem examinations, and in a case of recent fracture reported by me,† such a deceptive sensation was given that all who examined the patient's arm regarded the fracture as that described by Colles. Yet the post-mortem examination demonstrated the injury to be that described by Barton. From similar deceptive sensations Malgaigne was probably misled in his opinion about oblique fractures of this bone; and Hamilton, of New York, has also not been free from the same error of diagnosis, as he states‡ that he "has not recognized this fracture in any instance which has come under his observation, nor has he been able to find a cabinet specimen in any pathological collection," no post mortem having been made by him in this accident. Four well-marked examples of the fracture are, however, in my cabinet, with several others in the Museum of the New York City Hospital, and show

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* Treatise on Fractures in the Vicinity of Joints, etc., by Robert William Smith. Dublin, p. 137.

† Med. and Surg. Reporter, vol. ii. No. 1, April, 1859.

‡ Treatise on Fractures, p. 279, 1860.

clearly the character of the injury. The difficulty of the diagnosis deserves
therefore to be impressed on the mind of every practitioner, in order to pre-
vent deformity and an impaired usefulness of the hand of the sufferer.

**Prognosis.**—With such evidence of the liability to error in sprains of the
wrist and this fracture, as well as from the numerous instances of more or
less marked deformity liable to supervene, the prognosis of this fracture
should be guarded. As Mott, of New York, has stated, "even when the
fracture is well cured, an anterior prominence at the wrist or near it will
sometimes result;" while, owing to the effusions in the bursæ, thickening
of the ligaments, etc., a more or less impaired condition of the wrist-joint
will often continue for many months under the best treatment and most
assiduous attention. In my experience suits for malpractice in the treat-
ment of this fracture are frequent, three having been brought to my notice
in which the deformity complained of was due, in two to a defective prona-
tion and supination, and in the third merely to false anchylosis and thicken-
ing of the anterior carpal bursa. When early recognized, this fracture may,
however, be cured so as to give a perfectly useful hand. If unrecognized,
there will probably be impaired pronation and supination, long-continued
pain in the wrist, loss of power in seizing objects with the fingers, and in a
scrofulous patient the development of disease of the carpal bones; and the
danger of this result should be remembered in forming a prognosis.

**Treatment.**—As the seat of Barton and Colles's fracture, as thus de-
scribed, differs, and the deformity also varies, the treatment might at first
appear to be necessarily different. Yet this is not so. In both injuries per-
fect rest of the carpal articulation is necessary; in both the equalization of
the anterior and posterior surfaces of the upper and lower fragment is essen-
tial, to prevent deformity; and in both it is necessary to guard against in-
flammation of the carpal articulation and a tendency to luxation. With
some little modification to meet a lateral or posterior deformity and to pre-
vent promptly carpal arthritis, the treatment hereafter stated will answer
for both seats of fracture. The dressing recommended by Barton consists
of two compresses, about three inches by two, or else two and a half inches
square, graduated from one end, and two splints prepared as in fracture of
both bones of the forearm; together with a two and a half inch roller.
Then place one of the compresses on the front of the wrist, with its thick
end downward, about one-eighth of an inch above the articulating end of
the radius; place the other on the back of the wrist, with its thick end
upward, so that it may be on a line with the upper row of the bones of the
carpus, or on a line with the end of the first compress, and so that one may
begin where the other ends, though on opposite sides of the wrist. Fasten
these by a few turns of a roller loosely applied around the hand and wrist;
then place the two splints in their position, one on the front, the other on
the back of the forearm, extending them from the fingers up to the elbow,
and bind them there by the spiral bandage, as in fracture of both bones of
the forearm, Fig. 243. After a few days, increase the tightness of the band-
age moderately and make a slight motion of the joint, in order to prevent
anchylosis. If, instead of the bulging on the back of the hand, as generally
seen, that on its front should be most marked, we have only to change the
relative position of the compresses, and then pursue the same plan. This
dressing, I am informed, is the one mainly employed in the treatment of this
injury in the New York City Hospital.

As thus applied, Barton's dressing makes pressure through the compresses
upon the fragments, and retains them in position; but care is requisite not
to draw the bandages too tight at first, especially within the first ten days,
lest the compresses create too much pressure on prominent points about the

wrist, and inflammatory ulceration, or even sloughing, be induced; in which case the inflammation might extend to the wrist-joint and set up synovitis, etc. In one case, many years since, amputation was performed above the elbow in consequence of the mal-application of this dressing by an inexperienced dresser, the inflammation resulting in suppuration, sloughing, etc.,

Fig. 243.
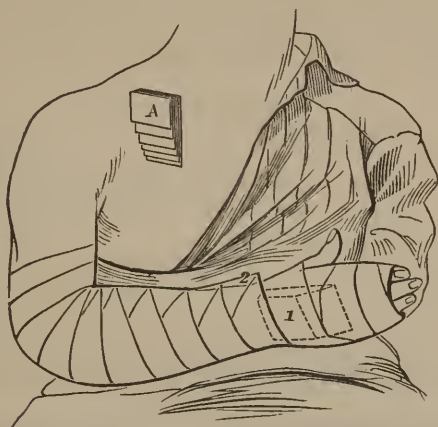


A VIEW OF BARTON'S DRESSING FOR FRACTURE OF THE LOWER END OF THE RADIUS, AS DESCRIBED IN THE TEXT.— A. The graduated compress. 1, 2. The thick end of each compress as applied to the wrist, and represented as seen through the splints and bandage, which retain them in position. (After Nature.)

that extended to the elbow. The bandage should, therefore, be loosely applied at first, and drawn firmer as it can be borne, though marked force is never necessary; the arm being then supported by a sling. After the first three or four days the dressings should be removed; and, while the hand is carefully supported, the parts should be well rubbed with a sponge wet with soap liniment, to relieve any congestion in the capillaries of the skin, especially over the os magnum or the seat of fracture, after which the dressing should be reapplied. About the sixth or eighth day, the same process should be repeated, and passive motion of the small joints of the fingers be at the same time carefully practiced, in order to prevent any probability of false anchylosis, an accident which occasionally ensues when the fingers are long kept at rest in splints if this precaution is neglected.

After two weeks, when the dressing is changed, passive motion should also be cautiously made at the wrist-joint, the fragments being carefully retained in position by the hand of the surgeon.

At about the same time, in many instances, the compresses may be omitted, the splints, if well padded, being sufficient. In four weeks and a half, in favorable cases, the splints may be left off and the forearm carefully bandaged to the elbow, when it should be supported with a sling, until the end of the fifth or sixth week, when the patient may begin to resume the use of the limb. By means of this plan I have frequently obtained very perfect cures in an injury which is often a serious one to treat without deformity; care and judgment being observed in its execution. If the splints and compresses are carelessly employed, there will be trouble in the integuments from pressure upon the bones of the wrist as well as more or less false anchylosis of the fingers.

Another excellent dressing for the treatment of this fracture is that suggested a few years since by Bond, of Philadelphia.*

The splint used by him for this purpose is made as follows :—

"1. With a light board, of proper thickness for a splint, take a profile of the well forearm and hand of the patient, placing the hand in its habitual inclination toward the ulnar side of the arm, and extending the profile from the elbow downward, so that it shall reach the second joint of the fingers on the inside, when these are moderately flexed—as much flexed as they are when the points of the thumb and fingers are brought into contact. The lower end of the board must then be cut off obliquely (at an angle of fifteen or

Fig. 244.

A board cut to correspond with the profile of the forearm and hand. (After Bond.)

eighteen degrees) in a direction corresponding with that of a body grasped in the hand, when the hand is inclined to the ulna, as above indicated, Fig. 244.

"2. Cover the board thus prepared with sheeting, or other strong fabric. This may be done by winding around it, from end to end, a narrow bandage, covering all of it as nearly as may be, with few or no duplications. This is the most expeditious method. A neater one is to cut a piece of sheeting, of the general form of the board, but extending beyond it on every side, and fasten this upon the board either by a few stitches, drawing toward each other the overlapping edges, or by gluing down those edges upon that side of the board which is to be toward the arm, these edges being covered with the pasteboard.

"3. Prepare a block of soft, light wood, from seven-eighths to eleven-eighths of an inch thick, and from two to two and a half inches wide, according to the size of the patient's hand, and of a length corresponding with the width of the board in the palm of the hand. This block is to be carved and rounded, so as to adapt it to the form of the hand, and make it easy for the thumb, and in the grasp of the hand when it is placed on the board. It is to be fastened there by screws or nails, so that the remote edge of it shall correspond exactly with the lower oblique end of the board.

"4. Upon that part of the board not covered by the palm block, fasten, by means of small carpet tacks, a piece of bookbinder's pasteboard, extending on each side beyond the edges of the board about an inch. If the pasteboard be very thick and stiff, make a slight incision in it along the edge of the board, in order to bend more easily the two projecting portions of it, thereby making a kind of box for the lodgment of the arm, Fig. 245.

"The flannel or other fabric with which the splint is lined should extend a little beyond the edges of the pasteboard, and the same piece may be extended over the palmar block; but it will be better to cover this block with a separate piece. For this purpose, take a piece of flannel large enough, when it is doubled, to cover the block. Through the doubled edge, with a proper needle, carry a small string, (such as ligature twine,) and tie this

around the splint immediately above the block.  The covering of the block thus applied may be conveniently changed, without removing the arm from its bed.

"Two compresses will generally be required: the anterior or palmar, and the posterior or dorsal.  The proper construction and application of the former of these is a most important point in this dressing, and certainly not less so when long, straight splints are employed; deformity of the radius or wrist most frequently resulting from negligence or want of skill in its use.

Fig. 245.
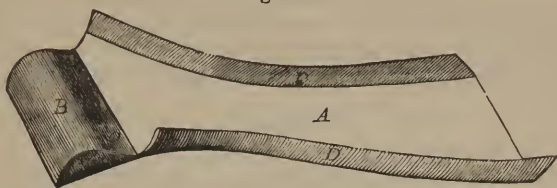


A. This whole space down to the palmar block B to be covered with pasteboard.  C, C. Parts of the block, which must be more or less cut away, to suit the prominences of the hand.  D, D. The projecting and elevated edges of the pasteboard.  (After Bond.)

If this compress be deficient in thickness, and the bandage be applied with its usual tightness, there will not fail to be either a curvature forward or a sigmoid flexure, these being the usual deformities.  If the thickness of this compress be excessive, there may be a curvature backward, though this, I think, seldom occurs; but there will be such undue pressure by such a compress as will increase the danger of adhesions, and aggravate the discomfort of the patient.

"In order to determine with precision the requisite thickness of this compress in any case, place a long, straight splint upon the palmar side of the uninjured forearm of the patient, and make a compress of such thickness as will fill the space, so that the splint applied shall bear as firmly upon the compress as the ends of it do upon the wrist and upper part of the forearm. It is to be observed that when the hand has its usual inclination backward, the space between the forearm and splint will be less, and of course require a compress of less thickness than when the hand and forearm are swathed upon a long, straight splint.

"After the forearm is laid into the splint, apply the dorsal compress. This compress is seldom essentially necessary in these cases; but it may always be advisable to use it.  Its thickness is comparatively unimportant, especially when a dorsal splint is not employed.  It may be made of folds of a bandage of about the width of the wrist, and so long as to cover the lower fragment of the radius and the wrist, but not extend upon the hand. After adjusting this compress, apply a roller, beginning upon the lower fragment of the radius, carrying it down over the wrist, the metacarpus, and the first joints of the fingers, leaving the thumb free; then returning with the bandage to the upper end of the splint, and attaching it in several places by pins to the woven covering of the splint.  If the compresses have been properly made and adjusted, it is unnecessary, with this splint, to apply the bandage with anything like the tension ordinarily employed in dressings with the long, straight splints; and those accustomed to the use of these splints will be liable to err on this point.

"A dorsal splint is unnecessary, unless the fracture occur so high up that there is danger of diminishing the interosseous space between the bones of the forearm.  In such a case it is necessary.  It should be so wide that the bandage will not pass upon the fragments in such a manner as to lessen the

interosseous space; and it should be so long as to reach from near the elbow to the hand, but not extend upon the metacarpus."

This mode of treating Barton's fracture has now been very frequently tested and always proved satisfactory. In several instances under my own observation, patients have expressed their satisfaction at the comfort derived from the position of the hand on the splint. I cannot, however, but add my experience to the suggestion made by Bond respecting the proper application of the anterior compress. It is absolutely essential to the cure, and unless it is sufficiently large to prevent the inequality of surface which exists between the carpus and the fleshy part of the forearm, the position of the hand on the block will tend to augment the anterior deformity.

**Hays's Splint.**—A very good extemporaneous apparatus for the treatment of this fracture, which answers the same purpose as Bond's splint, has been

Fig. 246.



Shape of Splint as cut from cigar-box. (After Hays.)

suggested by Dr. Isaac Hays, of Philadelphia.* It consists of the rough outline of the forearm, cut out of any thin piece of wood, as the top of a cigar-box, with a good thick roller bound in such a position as to supply the place of the block of Bond's splint; its application, with the compresses, etc., Fig. 247, being the same as that directed by Bond.

Fig. 247.
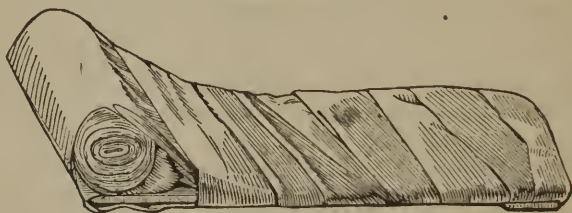


A view of the modified form of Bond's Splint suggested by Hays. (After Hays.)

Nélaton uses a splint shaped like a pistol, and applied to the back of the forearm and hand, the latter being inclined toward the ulna so as to suit the angle of the splint; E. P. Smith employing one with a hinge at the wrist, so as to vary the inclination at pleasure; but Barton's or Bond's dressing is ample, simple, and easily made at the moment. Hamilton's splint is of the shape of Nélaton's, but applied to the front of the arm and hand, inclined to the ulnar side instead of the back.

When stiffness and difficulty of pronation and supination remain after this treatment, passive motion should be daily made, and cold water poured from a height over the seat of fracture, as well as on the muscles of the forearm, to stimulate the local circulation.

* Am. Journ. of Med. Sciences, vol. xxv., N. S., p. 265, Jan. 1853.

# SECTION V.

### FRACTURES OF THE CARPUS.

**Fractures of the Carpus,** as might be anticipated from the size and position of its bones, are generally compound, and hence, in the treatment of this injury, attention to the condition of the joint and to the means calculated to combat inflammation is more demanded than any particular dressing applicable to the bones themselves.   Most frequently this injury results in anchylosis, and all that can be done by the surgeon is to see that this shall occur in the position most favorable to the usefulness of the limb. Indeed, a patient with a bad compound fracture of the bones of the carpus, produced as it generally is by very great violence, such as the hand being caught in the teeth of a cotton-gin, or injured by a gunshot wound; or from having, as sometimes happens, the wheel of a wagon pass over the hand, may think himself extremely fortunate if he escapes the risks and inconvenience of amputation, even though his hand remains afterward in a state of permanent anchylosis and comparative uselessness.

Nothing, therefore, in the way of apparatus, will be required, in the majority of these fractures, except a broad forearm splint, properly padded, upon which the hand and forearm may be supported by the light turns of a roller, while leeches, the cold or warm water-dressing, or other means likely to combat inflammation, are applied upon it.   As a general rule, the most successful results in these injuries will be obtained from the prompt and constant application of cold water by means of irrigation, as directed in the treatment of inflammation, cases having recovered surprisingly under this treatment after severe lacerations by machinery.   When the danger from inflammation has subsided, the parts should be kept at rest, or passive motion attempted, in order that anchylosis may be prevented if possible.

# SECTION VI.

### FRACTURES OF THE METACARPUS.

The bones of the **Metacarpus** are also liable to be broken at times, and by the same class of injuries, as a general rule, as those producing fracture of the carpal bones.   Although the fractures thus created may affect any of the metacarpal bones, still there are some which are most likely to suffer ; as the metacarpal bone of the thumb and those of the ring and little finger. The latter bones are often broken by falls upon them.   Of these fractures, that of the metacarpal bone of the little finger is perhaps the most frequent, as it forms the abutment of the arch of the hand, and, in falls upon the hand, sustains the chief weight of the body.   When a fracture occurs in the metacarpal bone of the thumb, it may be dressed with three straight splints, the one on the back and front of the thumb extending from the wrist to the end of the phalanx, while that on the outside of the bone should be only the length of the thumb.   These splints should be retained in position by the ordinary spiral bandage of the thumb.   Fractures of the metacarpal bone of the little finger, or that of the ring finger, may be dressed by a straight forearm splint, well padded, so as to fill up the hollow of the palm, preserve the arched shape of the metacarpal bones, and prevent any prominence of the fracture on the back of the hand, the splint being made to

extend all along the front of the forearm. Compresses may also be required on the back of the broken bones, to preserve their proper convexity, the whole being kept in position by light turns of a roller.

## SECTION VII.

### FRACTURE OF THE PHALANGES OF THE FINGERS.

**Fractures of the Phalanges of the Fingers** sometimes occur, but are by no means so common as might be supposed, when the exposed position of these little bones is taken into consideration, the mobility of the parts being such that they give way upon the application of violence in such a manner that dislocation is a much more common accident than fractures. Still, fractures are sometimes produced by violence applied directly to the bones themselves, as by blows of the fist, weights falling upon them, etc.

**Treatment.**—The treatment of these fractures is to be accomplished as follows: Mould the parts accurately into position, then take a narrow finger bandage, and, commencing at the wrist, make one or two circular turns to fix the bandage, which is then to be brought over the back of the hand to the extremity of the injured finger, and made to envelop it with the ordinary spiral of the fingers, so as to support the vessels of the skin and to prevent swelling. Then two long, narrow splints, long enough to reach from the wrist to the extremity of the injured finger, and about one-half or three-fourths of an inch wide, are to be padded with cotton, and covered with a bandage precisely like a forearm splint, and, one of these splints being placed upon the front and one on the back of the hand, two shorter splints, prepared in the same manner, being placed one on each side of the finger, the whole should be supported by the turns of a finger bandage, applied from the wrist, as just directed.

As in these cases the principal danger to be apprehended is anchylosis, either from the inflammation which is developed by the injury, or from the continued extension of the finger, necessitated by the treatment, the dressing, when changed, should be followed every few days by passive motion—the fragments being meantime accurately held in position—before the splints are reapplied.

If, however, the surgeon perceives it probable that anchylosis will ensue, notwithstanding his efforts to prevent it, owing to the violent contusion, etc., he should place the finger in such a position as will prove most useful to the patient when it is established, and that is semiflexed, a finger that is anchylosed in the extended position being constantly an annoyance, while a semiflexed position will enable it to perform many of the ordinary motions of the fingers.

## SECTION VIII.

### FRACTURE OF THE OLECRANON PROCESS OF THE ULNA.

The **Olecranon Process of the Ulna** may be broken by muscular action or by direct violence. In either case it will be at once recognized from the elevation of the upper fragment by the action of the triceps extensor cubiti, which causes it to take a position upon the back of the arm above the greater sigmoid cavity of the humerus. Hence the power of perfect extension of the forearm is lost, while that of flexion is still retained; the action of the biceps flexor cubiti and the brachialis internus remaining unimpaired.

**Symptoms.**—The symptoms of this injury are as follows: After a fall upon the elbow, or sometimes after some muscular violence capable of producing a rupture of the bony fibres, the patient finds himself unable to extend the arm, which is held in a semiflexed position by the action of the biceps and brachialis muscles. There is also violent pain, with swelling of the joint, and on passing the finger along the posterior face of the humerus the surgeon will soon feel an unnatural prominence on the back of that bone just above its sigmoid cavity, caused by the upper fragment being drawn above the joint, as before explained. If now the arm be extended, it will be found that the patient can partially flex it, but if it is flexed he will be unable to extend it, except to a very limited degree. When flexed, the space between the upper and lower fragments is, of course, greater than it is when the arm is extended, as extension of the forearm causes the lower fragment to approach the upper, while it also relaxes the triceps muscle, and thus renders the approximation of the upper fragment to the body of the ulna more easy. In some cases, however, the separation of the fragments is very slight at first, though ultimately greater. When this fracture is compound, especially if the elbow-joint is opened, the symptoms will be those of a wound of a joint, and the result will be most serious—either amputation of the arm or resection or permanent anchylosis of the joint.

**Diagnosis.**—Flexing the forearm on the arm will so separate the fragments as to render the diagnosis easy, unless there is much swelling or the injury is of some duration.

**Prognosis.**—As the union of the fragments in this fracture is most generally effected by the formation of fibrous matter, it becomes important that it should be as short as possible, for the longer the intervening structure the greater the diminution in the action of the triceps. Thus, if the triceps muscle be elongated a quarter of an inch, the patient will no longer be able to extend his arm properly, and if half an inch, the power of extending the arm will be still more impaired; but even in the most favorable cases the extension of the forearm will seldom be as perfect as it was before the accident. In order, therefore, to prevent disappointment, the surgeon should inform the patient of this fact at an early period in the treatment.

Fig. 248.



View of a specimen which exhibits the usual site of a fracture of the olecranon process, with the position of the ligamentous bond of union in a degree which would materially impair the usefulness of the arm in extension. (After Fergusson.)

The reason why the bond of union in fractures of the olecranon is so universally ligamentous is owing, it is thought, to the fact that the vascularity, and consequently the vitality, of this end of the ulna, depend almost entirely upon the supply of blood derived from the nutritious artery, which passes into the bone near the middle of its shaft, whence it is distributed throughout its substance, the periosteum here being very thin. When, therefore, the bone is broken just below its olecranon process, it will be perceived that the upper fragment has no supply of blood except the small quantity derived through the tendon of the triceps or the ligaments which are inserted into it; and this is not sufficient to enable such changes to take place on the surface of the upper fragment as would result in the formation of callus. The fibrous matter which unites these fragments is often very strong, but, as it allows them more or less separation, it in effect lengthens the triceps muscle, and thus diminishes its power, Fig. 248.

**Treatment.**—The indication in the treatment of fractures of the olecranon consists in counteracting the action of the triceps muscle—thus bringing the upper fragment down upon the lower—and in obviating the tendency to inflammation and the formation of lymph within the joint, which may in these cases create partial anchylosis of the elbow.

In order to treat this fracture as successfully as possible, the forearm should be well extended, and the fragment, which is drawn up by the triceps muscle, be drawn down into position by the surgeon's fingers and carefully kept there; the action of the triceps being counteracted by a straight splint applied on the front of the elbow or bend of the arm. The dressings which have been suggested for this purpose are very varied. That most frequently employed, and perhaps the most simple, is the dressing originally suggested by Dessault, which is applied as follows:—

**Dessault's Dressing.**—The forearm being extended upon the arm, the surgeon should endeavor, by pressure upon the belly of the triceps with one hand, to counteract its contraction, while using the fingers of the other hand as a hook to draw down the upper fragment, picking up at the same time, or directing an assistant to pick up, the skin over the elbow-joint, in order to prevent its being caught and pinched between the fragments. Then, commencing at the wrist, apply the ordinary spiral bandage of the upper extremity, ascending the arm till the bandage reaches the elbow, when the joint should be covered in by figure of 8 turns in such a manner as to hold the two fragments closely in apposition, after which the bandage should be continued up the arm to the shoulder, in order to compress the triceps and counteract its contractions. Then, placing a little wadding in the bend of the arm to prevent pressure upon that point, apply a straight splint of wood long enough to reach from the middle of the arm to the middle of the forearm, and bind it in position by the ordinary turns of a roller, Fig. 249, the dressing at first being loosely applied, lest it give rise to such excoriation and ulceration as may in the end become so serious as to require the dressing to be given up altogether. After a few days, the patient may be allowed to walk about with his arm hanging by his side in the extended position.

Fig. 249.
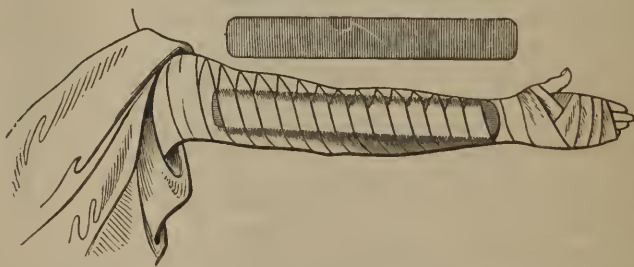


A view of the front surface of the left arm with the dressing applied in the treatment of fracture of the olecranon, showing the size and position of the splint. (After Nature.)

When three, four, or five days have elapsed, this dressing should be taken off, the fragments being held carefully in position by the hand of the surgeon, while stimulating frictions are employed, with a view of overcoming any capillary congestion of the skin; this friction being repeated whenever the dressing is changed, which should be at least every four days.

About the twenty-first day, the surgeon, while carefully holding the fragments in position, should make cautious passive motion of flexion, with a

view of avoiding anchylosis of the elbow-joint; and after six weeks, in the majority of cases, the dressings may be dispensed with, when the patient may begin cautiously to use his arm.

**Sir Astley Cooper's Apparatus** is composed of two strips of muslin, or tape, each about half a yard long; of two short rollers; of another roller of the ordinary length, and a light splint made sufficiently long to extend from the margin of the axilla about half way down the forearm, Fig. 250. Then, the patient's forearm being extended, and the upper fragment pressed down until it touches the shaft of the ulna, a strip of linen is to be applied above and below the joint, and one of the short rollers passed round the limb above, and the other below the olecranon, to secure them, as at *b b*. The extremities of each tape being reflected and tied together as at *a*, draw the rollers nearer to each other, and place the upper fragment of the olecranon in the closest apposition possible with the lower. Lastly, the split splint, *c*, well padded, is to be applied along the front of the arm, and secured by a bandage, *d d*, the latter being frequently wetted with an evaporating lotion. Care should be taken in setting this fracture to prevent the integuments being pinched between the fragments, lest it should prevent their union.

Fig. 250.
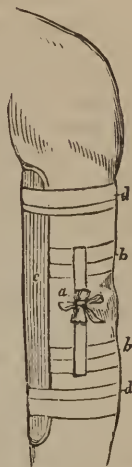


The after-treatment, where this apparatus has been used, is precisely the same as that which has been detailed in connection with the other dressings; that is, after ten or twelve days a slight degree of flexion is to be made at the elbow, and gradually increased to prevent stiffness, the fracture being maintained in its position, by the fingers of the surgeon, during this movement.

**Boyer's Method.**—According to this surgeon, the indications are to keep the fragments as closely as possible in apposition, without uselessly fatiguing the muscles by complete and constant extension of the forearm; and also by rest, to favor the formation of the ligamentous substance, without allowing the joint to become stiff.

In order to do this, he advises that the forearm should be slightly *flexed* on the arm, so as to make an obtuse angle with it, and then an ordinary spiral bandage applied from the fingers to the elbow. The fragment being now drawn down, a narrow strip or long compress is placed behind it, and fastened by crossing its ends in a figure of 8 around the forearm; after which the bandage is continued over it in the form of several figures of 8, and then carried by spiral turns up to the shoulder, so as to compress the triceps. To guard against anchylosis, motion should be made at the joint about the twentieth day, and at the forty-fifth the cure is usually complete; the union being then quite firm, and, as he says, as solid as it ever will be. Should there be much swelling or pain, he advises that the bandage should not be applied, or the reduction of the fracture attempted, but the limb be simply placed on a pillow, and the inflammation treated by local means. If the inflammation does not disappear by the twentieth day, the case may be left to nature; a number of instances, which he reports, having shown that even when thus left it will gain as much strength and freedom of movement as when confined more closely.

**The Carpo-olecranien Handkerchief of M. Mayor** has been already men-

tioned. It will answer very well, in many cases of this fracture, as a provisional dressing.

The Uniting Bandage of Gerdy, for transverse wounds and for fractured patella, is also applicable here; but as its use is more frequent in the patella than elsewhere, I shall reserve its description until I treat of that accident.

When the fracture of the olecranon is compound, or complicated with severe contusion, the effect of the inflammation on the joint renders its treatment the most important indication, and it will be better, therefore, to place the limb in the carved angular splint before spoken of, and confine it by a few strips of Scultet's bandage, employing leeches, cold washes, etc., as in compound fractures of the condyles of the humerus, than to use either of the dressings just mentioned.

Fracture of the Coronoid Process of the Ulna, if it should ever be found, will be recognized by its simulating dislocation of the bones of the forearm backward. By pulling the forearm, and at the same time flexing it, the dislocation is easily reduced, but returns again immediately on the force being removed. In order to prevent this, flex the forearm on the arm, applying the angular splint directed for the front of the arm in fracture of the condyles, and binding it firmly, so as to keep the elbow flexed for several weeks, the action of the brachialis internus, which is liable to reproduce the deformity, being prevented by the turns at the elbow. This accident is, however, a very rare one, and its occurrence doubted by many, though Physick reported having seen one case which he thus treated, and Sir A. Cooper and Liston have also seen one or two instances of it. From careful observation I am induced to believe that a fracture directly through the greater sigmoid cavity of the humerus has been mistaken for this injury, and though I cannot deny the examples cited, a practitioner should be on his guard when anticipating the existence of fracture of the coronoid. Hamilton, of New York, who appears to have diligently examined the cases reported by others as examples of this injury, doubts its occurrence as a simple, uncomplicated fracture.* I am unaware of any dried specimens proving its existence.

Various other plans have been advised, among the best of which is that of Alcock, which consists in pulling down the upper fragment by a strip of adhesive plaster applied in the form of figure of 8 of elbow, and then applying Dessault's dressing. Compound fractures of the olecranon are best treated by laying the limb in a carved splint, or one of tin or gutta-percha, and applying irrigation until the inflammation subsides, then dressing as a simple fracture.

* Treatise on Fractures, p. 209, et supra.

# CHAPTER VI.

## FRACTURES OF THE LOWER EXTREMITY.

In considering the general treatment of all fractures of the lower extremity, and especially those of the thigh, it is important not only for the comfort of the patient, but also for the success of the cure, that he should be carefully transported from the locality of the accident, placed on a proper bed, and such provision made in reference to his fecal and urinal evacuations as will insure perfect rest of the ends of the broken bone during its cure.

**Removal of a Patient.**—The directions to be given in regard to moving a patient will vary, of course, in accordance with the character and position of the injuries. In the majority of severe fractures of the lower extremities, it becomes the duty of the surgeon to suggest means for the accomplishment of this, not only in order to diminish his patient's suffering, but also that he may, if possible, be borne along without jarring the broken fragments, and thus augmenting the laceration of the soft tissue. For this purpose such means should be employed as can be most readily obtained. Where nothing better can be had, a shutter or door taken off its hinges will answer the purpose; but when a settee can be obtained, it furnishes the most convenient mode of transportation. If the patient is to be carried to his own dwelling, particularly if the house is small and the rooms narrow, care should be taken not to carry the settee into the room in such a manner as to bring its back to the bedside. This apparently trifling matter is one really of practical importance, as, if it be neglected, it may become necessary, as I have several times seen, either to carry the patient down stairs and bring him up again in proper position, or to lift him over the back of the settee, by which movement serious mischief may be done to the limb, and unnecessary pain created.

It is, therefore, an excellent rule in all such cases to ascertain, before the patient is carried up to his room, the general arrangements of the house, the position of the bed on which he is to lie, etc., with a view of obviating such difficulties.

In lifting the patient from the settee to his bed, if the femur is fractured, two strong assistants should slip their arms under him and clasp each other's hands by what is known as the "sailor's grip," that is, by placing the palmar surfaces of their flexed fingers together. These hands should be placed one under the shoulder and one under the hip of the patient, while an experienced assistant or the surgeon himself should lift the injured limb. The position of the assistants should also be so regulated that they may be able to lay the patient easily upon the bed—which should always be a narrow one—by one going on each side, when the patient may be gently deposited upon it, the hands being afterward withdrawn. When these details are overlooked, it often happens that the assistants so place themselves that one comes between the bed and the patient, and has then to crawl over the bed while sustaining the patient's weight, which incommodes all parties.

**Preparation of a Bed.**—Previous to this, if the patient has a fractured thigh, leg, cranium, or any injury by which he is likely to be confined to his bed for some days or weeks, the bed upon which he is to lie must be prepared for that purpose.   The necessity for such a proceeding is easily seen when it is remembered that a patient with a fractured thigh must lie on his back for six, eight, or twelve weeks without motion, during which time his bowels are to be moved every day, his urine is to be passed, his clothes are to be changed, etc., while all this must be done without producing any displacements in the fragments of the injured limb.   To accomplish this, some modification in his ordinary bedstead becomes necessary.   One of these, which constitutes an excellent "fracture bedstead," is that which in principle closely resembles B. H. Coates's bed,* and may be readily made out of any ordinary single bedstead by sawing its side near its middle into two parts, at about a foot distant from each other.   Then the piece thus marked off is to be split out with a chisel, so as to form a depression, Fig. 251.   Two cleets, similar to those of a counter drawer, are then to be nailed from one side of

Fig. 251.
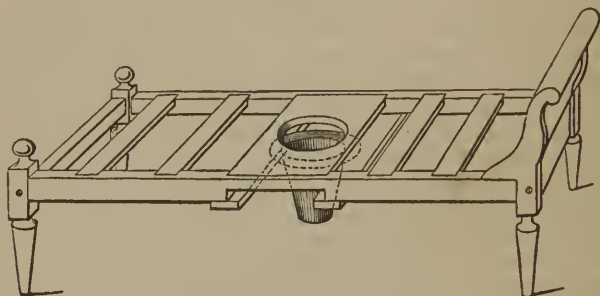


A representation of a Fracture Bedstead, as made by altering the ordinary single bedstead.   (After Nature.)

the bed to the other at the edge of the depression, at such a distance apart that a common chamber-pot, with a width of brim corresponding to the width of the groove in the cleet thus prepared, may be slid along it.   Such a bed should support its bedding with slats, not by means of a sacking-bottom.   If a slat bedstead is not at hand, one may readily be made by taking off the sacking-bottom, breaking off the pegs to which it is attached, and nailing on slats of wood, placed two, three, or four inches apart, according to circumstances.   The middle slat should be broad, and at its centre, corresponding to the position of the pot, there should be a hole cut out like a privy seat.   Such a bedstead can always be made from an ordinary bedstead at an hour's notice.   A good fracture bedstead, admirably adapted for the purpose, often difficult to obtain in private practice, but suitable for hospitals, is a simple iron bedstead, having at a proper point a round opening, which can be closed with a trap, and beneath which are proper arrangements for sliding in the pot.   Upon this, or upon the more domestic bedstead described above, the *fracture mattress* is to be placed.   This consists of an ordinary mattress with a hole in the centre, so made as to correspond with the opening in the bedstead.   To fill this opening, when not needed for necessary purposes, it is to be kept closed by a pad shaped like the cover of a privy seat, the edges being sloped so as to enable it to be slipped in and out under the patient's hips without disturbing his position in the bed.

* Eclectic Repertory, vol. ix. p. 543., Phila., 1819.

Although this fracture mattress is very readily made out of an ordinary mattress, still there may be difficulties in the way of obtaining it, or other causes may render it necessary or desirable to substitute a simpler arrangement, and the following is one that I have used for twenty-five years with great comfort to the patient.

Take four clothes props, or similar pieces of wood, and joint them into a frame; stretch a sacking-bottom or strong sheet over this frame, with a hole in the centre and tapes tacked along the edges to prevent the sacking from tearing out, as in Fig. 252, when, if the size of the frame is such as to project a little beyond the edges of the bedstead, a contrivance will be obtained which will answer every purpose, as it may be laid upon any ordinary bedstead upon which a mattress has been placed; an ordinary sheet, with a hole cut in the centre, being laid upon it and the patient placed on top of the sheet. Then when he desires to have a stool, it is only necessary to elevate the frame from the bed by means of assistants; to rest its ends upon the backs of four heavy chairs, or any contrivance made for the purpose, and place the chamber-pot beneath the orifice in the sacking-bottom. There is another recommendation of this frame, particularly in warm climates, or in the summer season, and that is, that as the patient lies constantly upon his back, his skin becomes sodden by perspiration, and he is predisposed to bed-sores, besides the discomfort which he necessarily suffers.

Fig. 252.



A view of the Fracture Frame for elevating patients from the bed, as described in the text. (After Nature.)

All this may be prevented by occasionally elevating him from his couch by some such apparatus as this, and a draught of cool air being thus made to pass beneath him, the danger of bed-sores is materially diminished. For the wealthy class of patients who desire a little more neatness, the fracture beds suggested by Drs. Coates,* Hewson,† Barton,‡ Daniels, etc., will be found useful, though more or less difficult to obtain at the moment.

Attention must also be paid to the mode of making such changes in the bedclothes and linen of the patient as are necessary during his confinement. As it is often exceedingly important, particularly in fractures of the thigh, to accomplish this change without compelling any motion on the part of the patient, it may be readily accomplished by a very simple manœuvre. In changing the shirt, take the garment and pass one hand in at the sleeve and out at the tail; elevate the patient's hands and arms above his head; grasp one of his hands so as to secure all his fingers, and prevent them from catching in the shirt, and draw it into the sleeve up to the shoulder, repeating the same motion on the opposite arm; then drawing the shirt well up into both of his axillæ, elevate his head a little and slip the shirt over it; after which it can be drawn down into the hollow of the back, but not below the hips,

* Eclectic Repertory, vol. ix. p. 543, 1819.
† Am. Journ. Med. Sciences, July, 1858.
‡ Eclectic Repertory, vol. v. p. 235.

or it will be liable to be soiled sooner than necessary. If it is desired to take the shirt off, it can be accomplished readily by movements directly the reverse of those just described.

The removal and replacing of the bedclothes is still more simple. The new sheet should be gathered up into a fold and laid under the neck of the patient, when the upper edge of the old sheet may be made fast to the lower edge of the new one, and as the patient hollows his back a little, or is eased up by assistants, the same motion which draws the old sheet from under him brings also the new one into its place. When, in changing the sheets, the splints, etc. are reached, as in a fractured thigh or leg, the surgeon should carefully take charge of them until the changes are completed.

These little points may by some be regarded as triflingly minute, but experience will recognize their value as closely connected with the comfort and welfare of the patient, great results being here, as in other instances, mainly obtainable by attention to minutiæ. Special fractures of the lower extremity now become the next object of study.

## SECTION I.

### FRACTURE OF THE FEMUR.

The **Femur** is a bone which, from its situation between powerful muscles, its shape and construction, is much exposed to fracture, and when broken is exceedingly difficult to keep in proper position during treatment. This fracture is liable, therefore, to give great trouble to the surgeon and to result in deformity—the latter, on account of the position of the bone, causing great inconvenience to the patient by laming him, more or less, for life. Hence fractures of the femur are of importance, and the indications to be fulfilled in their treatment, with the forces to be counteracted, demand careful study.

By referring to the character and variety of the muscular attachments of the femur, it will at once be understood that a fracture at different points in the length of the bone will give rise to special deformities, each demanding a particular course of treatment to overcome them successfully.

**Seat.**—Fractures of the femur may occur at any point of the bone, and are described as fractures through the head of the bone; fractures through its neck within the capsule; fractures lacerating the capsule and affecting the bone, both within and without this membrane; fractures of the neck entirely without the capsule; fractures through the trochanter major; fractures of the upper third of the bone; of the middle third, of the lower third, and of the condyles; all of which will occasionally require special forms of apparatus, in order to accomplish their successful treatment.

In few cases requiring surgical attention has there been as great a variety in the plans of treatment as in the fractures to which I now refer. Almost every year, and from every section of the country, we have accounts of some new modification, or some "decided improvement in apparatus, which, in the opinion of the inventor, and from the testimony of one or two perfectly cured cases, must supplant everything heretofore known;" when, perhaps, the great and improved modification consists only in the substitution of narrow strips for broad bands, or the difference of a buckle, or the peculiar shape of a hinge. To refer, then, to all these, would be as useless as uninteresting; and I shall, therefore, present only the simpler and more original plans in connection with each fracture, selecting such as are obtainable in most emergencies.

§ 1.—**Fracture of the Neck of the Femur or of the Bone within the Capsule.**

Fracture of the neck of the femur presents us with an injury that is sufficiently common. This fracture generally occurs in elderly persons, though not strictly limited to the aged, having been found as early in life as eighteen years, though at this age the accident is very rare, the subjects of it being most frequently on the shady side of fifty years; thus Malgaigne reports only fourteen who suffered from it who were under fifty years of age, while there were ninety, over fifty. Intra-capsular fracture is also more common in women than in men, owing to the greater width of the female pelvis, and the line of the force thus brought by falls, etc. to bear on the neck of the bone.

**Etiology.**—Among elderly persons, a fracture of the neck of the femur is often produced by apparently insignificant causes; thus, a patient while walking across the floor catches his foot in the carpet, feels something give way at the hip and drops upon his side, and from the fact that he generally falls toward the injured side or upon it, the fall has been supposed to be the origin of the fracture; hence we see it not unfrequently stated that the most common cause of fractures of the neck of this bone is the application of force to the trochanter major. A more careful investigation, however, would tend to show, from the line of the fracture, from its position, from the manner in which one fragment is sometimes driven into the other, and from the direction in which the capsular ligament has been torn, that the injury cannot have been thus produced in many instances, and that the fall has been rather the result of the fracture than the cause, the impaction of the fragments, after the fracture, being evidently due to the fall. We are led, therefore, to believe that in these fractures the solution of continuity in the bone is rather due to muscular or mechanical force applied to the foot; as when the foot is held by an obstruction, the contraction of the muscles, together with the forward tendency of the body, aided by the weight of the latter, would be sufficient to break the bone at its neck.

When a fracture occurs from muscular contraction, or from a force applied to the neck of the bone through its shaft, the fibres of the bone usually give way in a direction corresponding with the application of the force, and a fracture is created which runs from the exterior edge of the head through the neck, toward the base of the trochanter. When, on the other hand, the force is applied to the great trochanter, the fibres of the bone may be expected to yield in a different direction, the fracture running from the trochanter obliquely upward and inward, this fracture being also often impacted. (See Fig. 253.)

Fig. 253.

A representation of an impacted fracture of the neck of the femur through the trochanter; the upper fragment being wedged into the lower. (After Miller.)

The cause of the accident, therefore, becomes of importance, as showing the probable line of the fracture and the amount of injury sustained within the capsular ligament, this latter point being of value to the patient, from the fact that the greater the distance of the fracture from the insertion of

the capsular ligament, the greater the probability of a marked degree of shortening.

When the head of the femur or its neck within the capsule is the seat of fracture, it may be stated, as a general rule, though one also that has been much discussed, that osseous union will not take place; the bond of union in this, as in fractures of the olecranon and patella, being of a fibrous character, and for the same reason, to wit, the deficiency of periosteum, and consequently of the proper vascularity of the fragments, especially of that connected with the head of the bone. So uniformly has this fracture united by fibrous tissue, that the possibility of osseous union was at one time denied by surgeons of high standing—as Sir A. Cooper. As in the case of the patella and olecranon, however, bony union sometimes does take place in these fractures; and there is, in the Wistar and Horner Museum of the University of Pennsylvania,* a femur, apparently that of an old woman, in which the neck has been fractured near the head, yet in which complete osseous union, though with some degree of shortening, has taken place. In this specimen the head has sunk to the level of the trochanter minor, the neck is wasted in its circumference, and shortened, but is perfectly fused with the shaft. The bone has been boiled and etherized, and is a distinct specimen of this injury. I have, also, in my own cabinet, a specimen in which the bone has been fractured through the neck close to the head, the fracture passing obliquely across the neck within three lines of the point of fusion of the head and neck of the bone; the capsular ligament is dried and attached to the shaft, and the balance of the neck is normal. This preparation was obtained in Paris, at the Ecole Pratique. The injury must have produced marked shortening of the limb, and the *osseous* union is complete. (See Fig. 254.)

Fig. 254.



A front view of a fracture of the neck of the femur, within the capsule, in which there is perfect bony union. (After Nature.)

R. D. Mussey, of Cincinnati, also reports† three, and subsequently other specimens. Malgaigne‡ refers to three in the Dupuytren Museum. March, of Albany,§ reports two. Numerous other instances are well known. In Guy's Hospital Reports,‖ J. B. Hodgson reports three cases, with the postmortem examination, in which bony union had occurred after this fracture, with three others who walked perfectly well after the accident. The rarity of bony union is ascribed by Hodgson to defective treatment, his patients having been treated by the double inclined plane of pillows, with the foot secured so as to preserve the proper line of the neck of the femur to its head—his patients not being allowed to rise

* Philadelphia.
† Am. Journ. Med. Sciences, No. lxvi., N. S., p. 299.
‡ Treatise on Fractures, translated by Packard.
§ Trans. Med. Society of New York.
‖ Reports, vol. vii. p. 277, 1851.

for fourteen or sixteen weeks; and several others have been from time to time reported, leaving it beyond doubt that bony union is occasionally met with here, as in the patella, cranium, and other points formerly regarded as uniting invariably by fibrous tissue.    This extended evidence of experienced surgeons and careful observers has failed, however, to convince some who desire apparently to support theories rather than note the accumulation of facts, all of which they evidently discredit; and the question of osseous union in this fracture will, therefore, probably continue to be debated.    Those curious in studying the varied opinions on this subject are referred to a valuable paper published while these sheets are passing through the press.*  That osseous union has been seen, cannot reasonably be doubted, and from a careful analysis of the seat of the fracture in these cases, I think it is evident that there are a comparatively limited number of cases in which osseous union does occur; and I suggest that, as a general rule, based on observation, it will be found that the nearer a fracture is situated to the head of the bone, or, in other words, the shorter the upper fragment, the greater will be the probability of osseous union, because the shorter the upper fragment, the greater the chance that the vessels which supply it with blood through the round ligament will be able to furnish it with an amount of material sufficient to enable osseous union to take place by a deposit of bone from the Haversian canals.  On the other hand, the nearer the seat of fracture to the shaft of the bone, the greater the probability that ligamentous union only will result, though there will be a great amount of irregular ensheathing callus thrown out by the periosteum so as to support the fragments.    Rest, in a proper position, is therefore essential to a chance of success in the treatment of fracture of the neck of the femur within the capsule.    Why osseous union does not generally occur when the fracture of the neck of the femur occurs within the capsule, is explained by the fact that there is a large effusion of blood from the ruptured capillaries of the cancellated structure of the bone, which, being mixed with synovia, can act no part in the processes of reparation; but must, like any

Fig  255.



A view of three specimens of Intracapsular Fracture of the Neck of the Femur near to its junction with the shaft of the bone.  In all these specimens, though there is a considerable amount of callus formed on the shaft of the bone, so as to strengthen and support the fragment connected with the head of the femur, yet little or none is found in connection with the latter, union being imperfect in all the preparations, as shown after their maceration.  (After Nature.)

other foreign matter, be removed by nature before anything can be accomplished toward the repair of the injury; while the absence of periosteum on the neck of the femur causes a void in the cell action usually seen in the formation of callus.    As the broken surface next the shaft is freely supplied with blood, and also covered by periosteum, lymph will here be thrown out and become organized.    Not so, however, with the lower end of the upper

* The Insertion of the Capsular Ligament of the Hip-Joint, and its Relation to Intracapsular Fractures, by Geo. K. Smith, M.D. New York, 1862.

fragment; its supply of blood being derived principally from the vessels which reach it through the round ligament, many of which collapse, an imperfect effusion of lymph occurs, and a merely ligamentous union results, this union being, however, strengthened by the irregular callus formed near the shaft of the bone, as shown in Fig. 255.

If this explanation be correct, we must look for osseous union rather in fractures of the *head* of the femur than in fractures of its neck; and, in fractures of the neck, as more probable in those seated *near* the head than in those near the trochanter.    This, it will be perceived, is the reverse of what has generally been stated in works upon the subject; but it is a statement which seems to be borne out by specimens carefully observed by myself and others, though further observation is necessary to the establishment of the opinion.    Whether confirmed hereafter or not, it must be admitted by all that osseous union in fractures of the neck of the femur within the capsule is exceedingly rare; and, as the fibrous matter which furnishes the bond of union in the majority of instances is a very imperfect means of support, the patient is very apt to remain more or less lame; as, every time the weight of his body comes upon the injured limb, the latter gives way, and his body sinks to a degree equal to the length of the new ligamentous structure.    The longer therefore the bond of union, the more marked will be the limp, and the more imperfect the usefulness of the limb, and it becomes a matter of importance for the surgeon so to conduct the treatment that this ligamentous matter shall be as short as possible.

**Symptoms.**—The symptoms of fracture of the neck of the femur within its capsule are sometimes sufficiently difficult to recognize, and a diagnosis will only be correctly made by an accurate investigation.    Sometimes, however, the signs of the fracture are so plain as to be readily distinguished. They are usually as follows:—

After a fall in crossing the floor, as above described, or in crossing a gutter and tripping, or falling upon a curbstone, or sometimes, in very old persons, after an attempt to turn over in bed, in which the patient has caught his foot in the bedclothes, the following train of symptoms are observed:—

There is, as a general rule, a disposition in the foot to fall *outward*, in consequence of the action of the rotatory muscles, which are inserted near the base of the trochanter major, and slight force enables the surgeon to turn the toes outward and backward, which is impossible, as showed by Gerdy, if the pelvis is fixed and the neck of the femur unbroken.    The patient also complains of pain in the line of the joint, and is generally unable to flex his thigh upon his pelvis by means of the appropriate muscles, though he can do so by carefully raising the limb with his hand, or with his other foot; this motion, however, giving him great pain.

On examining the hips, before swelling has occurred, it will be seen that the prominence of the trochanter major is less upon the injured than upon the sound side, and that the fullness of the glutei muscles is greater upon the injured than upon the sound side; while, when the comparative lengths of the limbs are measured, the injured limb will prove to be from one-half to three-fourths of an inch shorter than the sound side.    This shortening, it should be remembered, will not be so marked immediately after the occurrence of the accident as it will be in the course of from twenty-four to forty-eight hours, when the muscles have had time to act, and it will be more marked when the capsular ligament has been lacerated than when that accident has not taken place.    Of course, on the other hand, there will be less shortening when the fragments are impacted.    In a marked case of impaction, indeed, there may be no shortening at all, no crepitus, no fullness of

the glutei muscles, and a failure of all the ordinary symptoms of fracture; and these cases are therefore exceedingly obscure, and difficult to diagnose.

**Mensuration.**—As the subject of shortening has been mentioned, the proper mode in which measurements should be made, with a view of ascertaining how much shortening exists in any fracture of the femur, may here be stated. If the shortening of the limb be judged by the comparative length of the limb, it will be in the power of the patient to produce, through accident or design, a marked amount of shortening, simply by a slight inclination of his pelvis or body. In order to avoid being misled by such a condition of parts, the surgeon should therefore observe the following rules :—

Lay the patient upon his back and draw an imaginary line with the eye, or a real one with a tape, transversely across his abdomen from the anterior superior spinous process of the sound to that of the injured side, so that the two anterior superior spinous processes of the ilia may be exactly on the same level ; or if they are not, adjust the patient so that this line may be at right angles to the length of the body. The position of these two processes being now marked with a lead-pencil or a pen, measure the length of the sound side by a tape drawn from the anterior superior spinous process of the sound side along the inside of the limb to the bottom of the internal

Fig. 256.
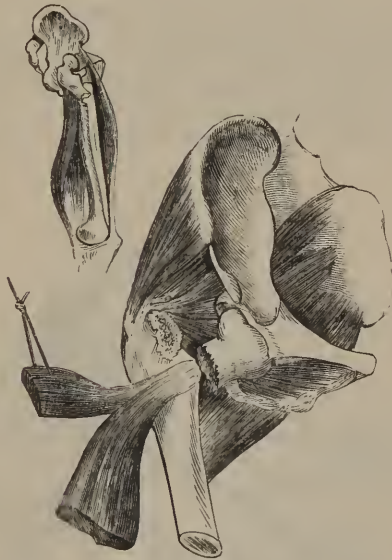


A VIEW OF THE MUSCLES CONCERNED IN THE DEFORMITY OF FRACTURE OF THE NECK OF THE FEMUR—ALSO OF FRACTURES OF THE UPPER THIRD.—1, 1. Psoas magnus and iliacus internus muscles turned off from the pelvis. 2. Muscles inserted into the trochanter and drawing up lower fragment. The smaller and upper cut shows the deformity in the upper fragment in fractures of the upper third of the bone. (After Hines.)

malleolus, after which the injured limb should be measured in the same manner. In fracture of the neck of the femur from one-half to three-quarters of an inch shortening will often be observed soon after the accident, but, as above stated, after some twenty-four or forty-eight hours, when the muscles have had time to act, and shortening has fully taken place, a greater degree may be noted, an inch or an inch and a half having been found, and one of

two inches being recorded, though the latter measurement seems somewhat exaggerated, if taken after the muscular spasm has passed away.

Besides the symptoms due to muscular action, the surgeon should recognize in these cases the ordinary symptoms of fracture of any bone. He should, therefore, endeavor to feel the crepitus; though in doing so he must proceed cautiously lest he do the parts a serious injury. In order to make the crepitus in a satisfactory manner, and at the same time do no harm to the patient, direct an assistant to seize the limb by the ankle and make moderate traction; then, placing a thumb upon the trochanter major, and a finger as near as possible to the trochanter minor, let the assistant rotate the limb gently. In this manner the crepitus will generally be made perceptible to the patient and to the surgeon; and being transmitted through the limb it will also often be distinctly recognized even by the assistant who has hold of the ankle. Besides this, the surgeon should notice the *character of the arc of the circle* described by the trochanter major during the rotation of the bone.

Under ordinary circumstances, the rotation of the femur, as indicated by the rotation of the toes from their extreme point inward to their extreme point outward, causes the trochanter major to describe an arc which is very nearly a semicircle, but after a fracture of the neck of the bone the trochanter will be found to describe a shorter arc than the sound trochanter on the opposite side.

The mechanism of the deformity in this fracture is very readily understood by referring to the muscles around the joint. Thus we have the action of the gemini, pyramidalis, and other rotating muscles, as well as of the large and powerful glutei muscles no longer antagonized by the continuity of the neck of the bone, and these therefore rotate the femur outward, thus causing the falling outward of the toes that has been already alluded to.

Fig. 257.
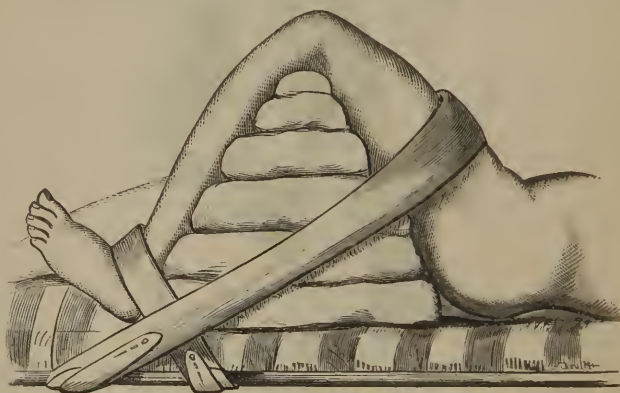


In addition to this, there is shortening, which is not only produced by the glutei, the adductor and other muscles acting directly upon the upper end of the shaft of the femur, but also by the quadriceps femoris, the semimembranosus, semitendinosus, biceps, and those muscles which, being inserted into the head of the tibia, tend to draw this bone toward the pelvis, and to produce shortening of the thigh when their action is no longer counteracted by the continuity of the neck of the femur. The eversion of the foot, however, is not a universal accompaniment of fracture of the neck of the femur, nor is it by any

means a positive sign that such a fracture has occurred, as a dislocation of the head of the bone upward and backward on the dorsum of the ilium may cause the toes to be turned outward in a similar manner, so that a diagnosis can only be made when eversion of the foot is seconded *by the presence of the other signs of dislocation.*

**Diagnosis.**—By comparing these symptoms with those hereafter detailed in connection with Luxations of the Head of the Femur, a diagnosis may be established, though often attended with great difficulty, the surgeon being sometimes unable to make a positive diagnosis for days.

**Prognosis.**—The prognosis of fracture of the neck of the femur will depend upon the age of the patient, and other concomitant circumstances; thus, in a man of fifty there would be more probability of bony union than in one of seventy years of age. In a case of impacted fracture there would also be less shortening, and the patient would have a more useful limb than in a case of oblique fracture through the neck. As a general rule, however, an unfavorable prognosis should be given, the patient being frankly told that in all probability he will always walk with a limp, for not one case in a thousand unites so as to give a perfect limb.

**Treatment.**—The simplest and best plan of treatment in an injury of this kind, in an old person, especially if of feeble health, is not to sacrifice life to the attempt to prevent lameness. In these cases it is best, therefore, to place the patient on a mattress, and, folding one pillow, or several, as in Fig. 257, so as to make a double inclined plane, place it beneath the knee so as to retain the limb in a flexed position, keeping him in this position for about six weeks, and then transferring him to an arm-chair. Or, if a tendency to the formation of bed-sores be developed, he may be set

Fig. 258.
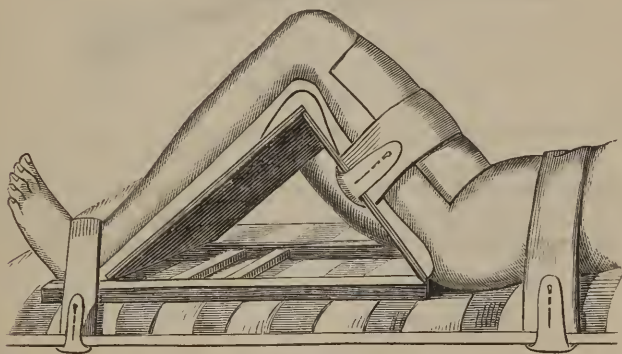


A representation of the Double Inclined Plane applied to such cases as are described in the text.

up earlier, being taken out of bed at the end of the second week, placed in a chair, and allowed to recover with deformity, as indeed he is very apt to do under the most perfect apposition of the fragments. But in a younger patient in good health, capable of sustaining a confinement to bed for fourteen weeks, a firmer double inclined plane, such as that of Chapman, of England, Fig. 258, or of Amesbury, may be employed.

§ 2.—**Fracture of the Neck of the Femur without the Capsular Ligament.**

In a Fracture of the Femur outside of the Capsular Ligament—that is, the highest point of the shaft—there are two fragments, both well supplied with blood, the lower end of the upper fragment obtaining it through the arterial foramina seen in the neck of the bone; vessels entering here chiefly through the insertion of the ligament connected therewith, while the shaft is freely organized. Osseous union, if the fracture be properly treated, is therefore of more frequent occurrence outside the capsule, and it becomes a matter of importance to overcome the deformity, and place the parts as perfectly at rest as possible. This fracture, moreover, happens generally to people less advanced in life, and in whom the reparative effort is more active. The best mode of treatment is by means of a firm, properly-made inclined plane, as shown in Fig. 258.

Another very excellent apparatus for this purpose, made of sheet-iron, so as to fit the limb, padded, and capable, by means of screws, of being elongated to suit any limb, or of being adjusted at any angle, is the apparatus generally known as McIntyre's splint, Fig. 259.

By means of either of these splints the limb may be efficiently secured, the foot being attached to the foot-board, and the extension made from the bend of the knee by binding the leg to it with a bandage, the counter-extension

Fig. 259.
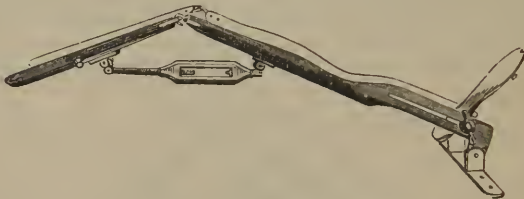


A side view of McIntyre's Splint as formed into a double inclined plane by the action of the screw beneath the knee. (After Fergusson.)

being made by the weight of the body, when the whole limb is secured by a bandage. Very good cures have been thus effected, and the apparatus is lighter and neater than the double inclined plane of wood alluded to before.

Fig. 260.



A side view of Liston's modification of McIntyre's Splint, showing its attachment to the limb, etc. This splint is also very useful in the treatment of compound fractures of the leg, as shown in the cut. (After Liston.)

**Liston's Long Splint.**—There is another mode of dressing fractures of the neck of the femur just without the capsule, and fractures of the tro-

chanter, which has also been applied to fracture of the shaft of the femur, and that is by the one known as Liston's splint. This is a simple splint, long enough to go from the axilla to about six inches below the foot, and perforated with two holes near its upper extremity, while at its lower end two deep notches are so cut as to divide the lower extremity into three points; besides which, an opening is made so as to receive the external malleolus.

In its application, a junk-bag is laid along the splint from one end to the other, and tied in position with several tapes. Then, an ordinary roller being torn into two tails, one tail is passed through each of the holes at the top of the splint and tied on the outside, when the roller should be carried smoothly down over the junk-bag to the inferior extremity of the splint, so as to obtain a firm connection.

Fig. 261.



A handkerchief or towel should now be folded into a cravat and placed in the perineum with a view of making a moderate degree of counter-extension and drawing the limb outward toward the splint. Then, having laid the splint on the outside of the limb, and brought the roller down over the junk-bag till the foot is reached, a turn is to be made around the foot, and the bandage carried down around one of the points at the extremity of the splint back to the foot, around which another turn should be taken to one of the points again, and so on, until a firm hold is obtained of the foot so as to make the extension; counter-extension being kept up by means of the handkerchief in the perineum, which is to be made fast to the two holes in the top of the splint. Having thus fastened the foot by means of the turns of the roller to the points at the bottom of the splint, bandage the limb and splint together all the way up to the groin, the perfect extension and counter-extension of the splint preventing displacement while the limb is raised sufficiently to permit the application of the bandage.

By means of this apparatus, a moderate extension and counter-extension will be kept up, the trochanter be pressed in upon the neck of the bone, the parts be kept at rest, and very good cures accomplished at a point where it is difficult to apply a retaining force by any other means. In the *extra-capsular* fracture of the neck of the femur I have found this a useful dressing, but do not like it so well in fractures of the shaft of the bone.

Fig. 262.
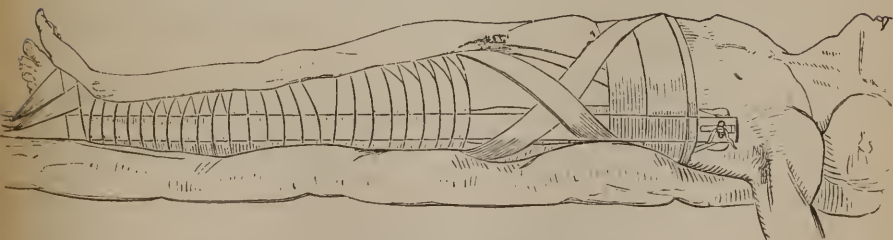


A view of Liston's Splint as applied in fracture near the trochanter, or any other portion of the shaft of the femur. (After Liston.)

### § 3.—Fracture of the Shaft of the Femur.

Under the head of Fracture of the Shaft of the Femur are placed, by systematic writers, all such fractures as happen at any point between the trochanters and the condyles.    This fracture may occur at all ages, though it is most frequently met with in the middle aged, 130 being reported by Malgaigne as under 40, and only 70 above that age.    It may be produced by mechanical violence or muscular action, though the latter is rare, except when seen in those whose bones are diseased.    It is also a frequent accident, 207 out of 2328 reported by Malgaigne being seated in the shaft, and only 5 at the condyles.

**Symptoms.**—The symptoms of fracture of the shaft of the femur are usually well marked, and consist of severe pain, inability to move the limb, screaming when motion is attempted, with deformity and crepitation when manipulated, or when the muscles act either voluntarily or spasmodically. The deformity in this fracture varies somewhat in accordance with its seat; thus when high up, the lower end of the upper fragment tends to project in

Fig. 263.



A front view of the Action of the Adductor Muscles in creating one form of deformity in fracture of the middle third of the femur, with a side view of the position of the foot, the eversion being aided by the leverage of the leg.   (After Hines.)

consequence of the action of the psoas magnus and iliacus internus muscles, which, being inserted into the trochanter minor, cant this fragment forward. At the same time the flexors and extensors of the leg induce shortening of the femur by drawing the lower fragment upward and backward.    In fractures of the *middle third* of the femur, the shortening is marked, the upper end of the lower fragment being also drawn backward; and in ten specimens of fracture of the shaft now before me all have the lower fragment projecting backward and overlapped by the upper portion, while the adductors, etc.

displace one fragment angularly inward, or the weight of the leg and the rotator muscles at the hip-joint create displacement in accordance with the circumference of the bone—that is, by rotation.

**Diagnosis.**—The diagnosis of fracture at this portion of the femur is, therefore, usually easy.

**Prognosis.**—The prognosis of this fracture should be guarded.    In a few favorable cases excellent cures have been obtained—that is, without any defect in the gait of the patient; but generally there will be found, on accurate measurement, at least the shortening of a quarter of an inch, though this is not perceptible in the gait.    Knowing the difficulties to be encountered, I do not hesitate to assert that in the majority of cases a shortening of a half to three-fourths of an inch by accurate measurement should be regarded as a good cure, and without great care and attention on the part of the patient as well as of the surgeon this will not be obtained.    In children, and those under 15 years of age, the prognosis is much more favorable, these cases recovering more rapidly, and, as experience shows, with less shortening and deformity than is the case in adults.    The duration of the treatment in those under 18 years, and in favorable circumstances, will usually require six weeks. In adults with oblique fractures I generally allow ten weeks before removing the apparatus, and then apply a pasteboard thigh-splint for two weeks, while the patient moves on crutches.

**Treatment.**—In few fractures have surgeons suggested more varied plans of treatment than in those of the femur.    Without attempting even to mention all of these, I would advise the inexperienced practitioner to take the simplest that is adapted to the case, and to shun all the patented, costly, and usually very attractive forms of apparatus sold by inventors and their agents. The treatment of fracture of the shaft of the femur demands the employment—first, of a good, firm, even mattress; second, some arrangement to give the patient a stool without in the least moving the broken bone; third, a glass jar or urinal to prevent the wetting of the dressing, and the chafing and sores that ensue; fourth, relaxation of the muscles by the use of anæsthetics, in order to set the fracture; fifth, good means of preserving extension and counter-extension to prevent the muscles from again creating displacement; sixth, splints to insure stability of the fragments.    Each of these will be separately considered.    As the preparation of the bed has been already alluded to, we shall first examine the means of inducing muscular relaxation.    The older surgeons were accustomed to laud highly the influence of position in relaxing the muscles, especially during the continued treatment of the fracture.    Although very useful, yet, with the introduction of ether, the influence of position has lost some of its importance in *setting* a fracture, and the reduction may now be promptly and thoroughly accomplished, and the first dressing made, while the patient is in a state of anæsthesia.    Then, to prevent any recurrence of the displacement from muscular action, the straight position of the entire lower extremity maintained by splints, with good extension and counter-extension, is the best plan of treatment.

**To keep up Extension.**—Passing over the ancient methods of preserving extension when it has been made by the hands, I shall limit this account to that obtained by the use of adhesive plaster, the utility of which has been so marked as to bring forward several claimants for the suggestion, as Gross and E. Wallace, of Philadelphia, and Crosby, of New Hampshire.    Of the priority of these claimants it is difficult to decide, but it was certainly but little known or used in Philadelphia until Wallace called attention to it. Adhesive strips should be applied as follows: Shave the surface of the leg, and cut a strip of adhesive plaster two inches wide and long enough to reach

from the head of the fibula four inches below the sole of the foot, and up on the inner side of the leg to the head of the tibia. Then cut another strip of plaster of the same width and fifteen inches long, and obtain a block of thin wood three inches by four. Place the block directly in the middle of the longest strip, and, warming both strips, apply both of them to the block by their adhesive faces, the middle of each strip corresponding to the middle of the block, and make them adhere to each other and inclose the block; then, warming each end of the longest strip, apply one end on the outer side of the leg from below the knee, as far down as is possible, until you reach the muslin surface of the second strip. Do the same on the inner side of the limb, and pass one or two short pieces from one side strip across the front and back of the leg, at different levels, so as to assist their adhesion and firmness, making no traction for an hour, that the plaster may become firmly adherent to the skin; then, on drawing on the block, included between the strips, an even surface will be obtained for the attachment of a tape, while the inner strip will prevent any attachment of the plaster to the sides of the ankle or foot, thus preventing ulceration of the skin over the tendons and bony prominences around the ankle and heel. As thus applied the strip

Fig. 264.



A SIDE VIEW OF THE EXTENDING BAND AS MADE OF ADHESIVE PLASTER, AND APPLIED TO THE LEG IN ALL FRAC-TURES OF THE FEMUR AND LEG WHICH DEMAND THE EMPLOYMENT OF AN EXTENDING FORCE.—A. The broad outside strip which is retained by the cross strips 1, 2, 3 passing over to a similar wide strip on the inner side of the leg—this strip being one entire piece. B. The little block placed in the loop of the side strip where it passes beneath the foot, thus furnishing a firm support to the tape which is to be attached to the lower end of the splint, while it also keeps the pressure of the extending band off the sides of the foot. (After Nature.)

will often not need renewing for ten to twenty days unless in warm weather, while the extending force will be firmly and equably applied without creating the ulceration formerly so constantly seen with the handkerchief or garter. If adhesive plaster cannot be obtained at the moment, form with a bandage of flannel four inches wide (if an adult) a series of figure of 8 turns, embracing the leg and ankle or instep. Then stitch or pin firmly, on the portion of this which covers the malleoli, two broad tapes, and tie them on the lower end of the splint, as before directed. The extension will thus be made from the malleoli; the bandage will be elastic, and, therefore, not painful, and the perspiration being readily absorbed, there is but little tendency to that maceration of the cuticle which is so often the starting-point of ulceration.

In order to aid the extension, the tapes are sometimes attached to the plates of a tourniquet, or to a screw.

Counter-extension.—This, like extension, is best preserved by attaching the limb to the splints by means of adhesive strips, as suggested by Gilbert, of Philadelphia.

Gilbert's Plan of preserving Counter-extension.—Take two adhesive strips, two and a half inches wide and two feet long, and, after warming them, attach one to the posterior surface of the pelvis, from the perineum and inner and anterior surface of the thigh to a point above the crest of the ilium, and bring the other from the perineum and posterior face of the thigh up in front over the upper part of the thigh, and up inside the crisa

of the ilium to meet the posterior strip.   Then carry the posterior strip to
the upper mortise hole in the outside splint, and the anterior to the lower
hole of the same splint.   By this arrangement the inner extremities of the
strips cross each other at an angle of 100°, and extend four inches beyond
on the perineum, while their external ends also cross each other as they
approach the splint.*

Gaston,† of South Carolina, has also employed counter-extension by
means of adhesive plaster by warming a strip two inches wide and apply-
ing it closely over the groin, spinous process, and crest of the ilium as far
as is possible, carrying the other end of the strip through the top of the
external splint while a second is made to adhere to the trochanter major,
and thence up and behind as far as possible before passing to the splint.
By these attachments he claims to gain two firm points of attachment, owing
to the close adherence of the skin to the bones at these points.

Lennox Hodge, of Philadelphia,‡ to obviate inconveniences experienced
in Gilbert's plan, advises the use of a strip of adhesive plaster two and a
half inches wide, applied from the middle of Poupart's
ligament, in front of the body, up and over the shoul-
der, four inches beyond it so as to leave a loop in
which a block of thin wood is to be fastened, as
described in the extending band, and then the strip
continued down the back of the chest and loins as
far as the lowest point of the buttock, or to the
tuberosity of the ischium.   Three other strips of plas-
ter passing entirely around the body at equal dis-
tances from the pelvis to the shoulders render the first
strips firm.   A tape passed around the block is attached
to a special splint, as hereafter described.   These
bands do not incommode the patient by constricting
the chest or abdomen, and will hold perfectly for at
least two or three weeks.   A slight modification in
the line of the perpendicular strip will render it equally
applicable to the long splints for fractured femur.

Fig. 265.



All of these plans have their advantages, and that
should be selected which is least liable to press on
the skin over the edge of the pectineus and adductor
muscles, and in children and females least liable to be
wet by the urine.   As a general rule, those of Hodge
and Gaston are least objectionable.   To prevent the
soiling of the apparatus, chafing, etc. that is apt to
ensue in any case where the dressings are liable to be
wet, they should be well painted, after being applied,
with *oil varnish*, at such points as are exposed to
moisture—this will add greatly to the patient's com-
fort.

When adhesive strips are not obtainable, a cravat
or soft shawl folded and applied to the groin, so that
its ends will pass obliquely to the brim of the pelvis
in front and behind, and thence to the splint, will answer for a few days.
In the splints of Hartshorne, Boyer, or Horner, as hereafter described, the
counter-extension is made at the perineum by the splint, and no strips are

required. These splints will be described in each case as applied to the treatment of the seat of fracture. If the splints are not padded, stuffed bags called *junk-bags* should be prepared as follows, so as to prevent the direct pressure of the splints against the side of the limb, as well as to equalize the pressure. They should be made of muslin of the length of the limb, or, rather, long enough to extend on its outside from the pelvis to the external malleolus, and on the inside from the perineum to a point a little above the same process internally. One end of the bag being sewed up, it is then moderately filled with bran, straw, or chaff, and the open end being likewise closed, it will form a cushion of the width of the splint, and like Fig. 266.

Usually a simple fracture of the shaft of the femur will not require compression by the application of a bandage. But should circumstances, as a wound, suppuration, or a compound fracture, demand it, that of Scultet will be the best, as its application and reapplication may be made without moving the limb.

**Scultet's Bandage** is made of strips of muslin, about three inches wide, and of a length gradually decreasing from the first piece, this strip being long enough to go once and a third round the upper part of the limb, each succeeding portion being one inch shorter. To prepare and apply this bandage, lay the strips down on a pillow or board, (so that the whole may be readily placed under the limb without being deranged,) placing each strip so that it

Fig. 266
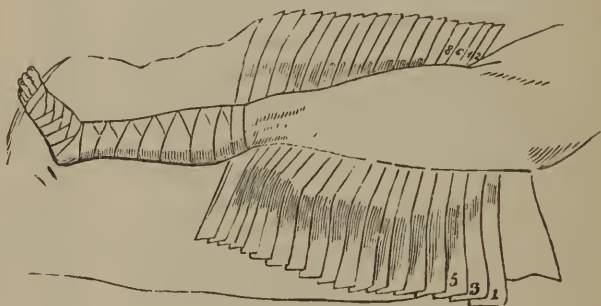


shall cover only one-third of the preceding one. Then lay the limb on these *obliquely* in regard to their length, in order to favor their application, com-

Fig. 267.



mence at the lowest part of the limb and gradually ascend, drawing each strip moderately tight, Fig. 266. When it is necessary to change one or more of the strips, undo the bandage, and, attaching the fresh band to the soiled one, draw the latter out, and thus draw the fresh one into its place without deranging the limb.

The **Eighteen-tailed Bandage** consists of a piece of muslin three inches wide, and as long as the limb, to which are stitched crosswise eighteen or more strips of equal width, sufficiently long to make a turn and a half about the part, and cover in each other by about two-thirds. It was formerly used for the same purposes as the bandage of Scultet, but has been supplanted by it in consequence of the impossibility of changing a single strip, owing to its

attachment to the centre piece. Should firmer support of the thigh be demanded, a splint to surround the thigh, like Fig. 267, may be resorted to.

The splints and apparatus for fractured femur differ in their form. The apparatus of Dessault consist of one for the outside of the limb, long enough to reach from the spine of the ilium to four inches beyond the foot; and of another extending from the perineum to the sole of the foot, both of the width of the limb. In the upper part of the outside one are holes to receive the counter-extending band; its lower end having only one hole for the extending band. To these are added a splint for the front of the thigh, junk-bags, Scultet's bandage, etc., as shown in Fig. 268.

Fig. 268.
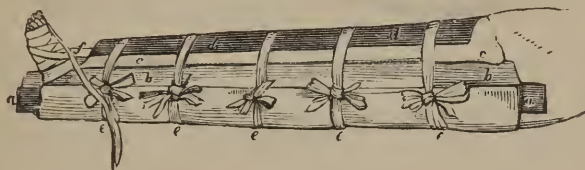


Being liable to the objection of not preventing lateral inclination of the pelvis, they are now but seldom used except by the French surgeons. Their application is shown in the cut.

**Physick's Splints** are a modification of these, the addition being in the length of the outer splint; in consequence of which its end reaches nearly to the axilla, thus making the counter-extension more in the line of the body, and preventing any inclination to that side. The addition, by Hutchinson, of a notched block over which the extending band is stretched, makes the direction of the extension more in the line of the limb. The remainder of the apparatus is the same as that just described. With slight modifications, this is the dressing mostly employed in Philadelphia; and as the experience of the large number of cases treated proves it to be all that is requisite for simple fracture of the shaft of the bone, I can safely recommend it as the most simple and efficient means of treatment.

In its application, having arranged the patient, the bed, and the extending and counter-extending strips, as before directed, place the junk-bags on the splints, and make their stuffing to correspond with the prominences and depressions of the limb; then press the outer splint to the side of the limb against the junk-bag, and tie the counter-extending tapes through the holes at its upper part. Then the extending tapes being passed over the block, and one of them through the hole at the lower end of the outer splint, both are to be tied on the extremity of the splint so as to secure the extension gained by the hands of the surgeon; he keeping up this extension till the bands are fixed and the outer splint in its place. The junk-bag being then arranged on the inner splint, and it turned up against the side of the limb, pass three pieces of roller under the hollow of the knee, and slide them up and down the limb to their position, tying them on the side of the splints, so as to keep the whole apparatus close to the limb, fastening them by a tack to the splints to prevent lateral deformity. Looking now to see that the patient's body is perfectly straight in regard to his limbs, which may be told by noting that the two anterior superior spinous processes are on the same level, measure from them to the internal malleolus of each limb, to see what is the difference in their lengths. Then place a hoop, bent as in Fig. 269, over the toes, to keep off the weight of the bedclothes, and the dressing is completed. If, after two or three days, or even ten days, we find there is

still shortening of the limb, make the extension with the hands as before
directed, and thus daily drawing on the limb, pull it down and tighten the
bands till it is of the same length, or as much so as possible.

Fig. 269.
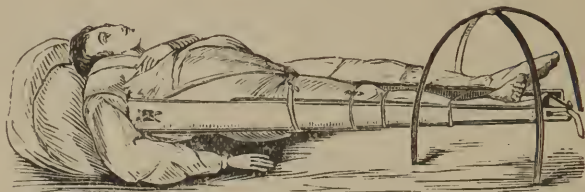


Generally, the reduction of this fracture is completed at the second visit;
but I cannot too strongly caution the young surgeon against believing that
a fractured femur will in all cases, or in the majority of them, be perfectly of
the length of the sound one.   In favorable cases the difference will scarcely
be perceptible, but if attention is not paid to the position of the spinous pro-
cesses he may readily deceive himself, and prove the limb as long or even
longer than the sound one.   During any change in the apparatus, the exten-
sion and counter-extension should be carefully maintained by the hands of
assistants until the splints are reapplied, all motion of the fragments being
avoided.

In this method it is seen that the bandage of Scultet, and others, or
short splints on the front or back of the thigh, as well as the splint cloth,
are dispensed with, no advantage being derived from their use in the
majority of cases; while we can, owing to their absence, examine the state
of the fracture, apply cold washes to combat any inflammatory action, and
yet not derange the limb by their application.   Should the case, however,
prove one of very oblique fracture, and especially at the upper third of the
bone, the anterior and posterior short splint, with the application of Scul-
tet's bandage to the thigh, will, I think, be found of great service; and, if
the strips are not tacked fast to each splint, it will be necessary to wrap
them up in a splint cloth, to prevent their separation from each other.

**Boyer's Apparatus** "is composed of a splint of a particular construction
for extending the limb; a foot-board; a padded belt or perineal band, which
is buckled round the upper part of the thigh; two common flat splints of
the length of the limb, one for the anterior and the other for the internal
part of the thigh; and some junk-bags, tapes, and wadding.

"The outside splint is about four feet long and three inches wide.   Along
half its length runs a groove about half an inch broad, the extremity of which
is covered with iron; to this groove a screw is adapted, which occupies its
whole length, one end of it being supported against the plate of iron covering
the extremity of the groove, and the other made to fit a handle, by means of
which it can be screwed up.   On the inside of this splint a contrivance for
holding up the foot-piece is fastened to the screw, and the upper part of the
splint is received in a sort of pouch or bag adapted to the external side of
the perineal or thigh-belt.   The sole-piece or foot-board, which has two
branches at its inferior part to steady it when resting on the bed, is made of
iron, and covered with soft leather.   This is connected by means of a me-
chanical contrivance, as just mentioned, with the screw.   To that part of
the sole which is near the heel is attached a broad piece of soft leather,
which, being split on each side into straps, serves for fixing the sole to the
foot.

"The perineal band is of strong leather, covered with buckskin, and well stuffed with wool; near the place where its two ends are buckled together on the limb, a little leather pocket is sewed, for receiving the upper end of the external splint. The patient being then properly disposed upon the bed, a splint cloth is passed under the limb and laid upon five tapes. In the next place the perineal band is applied, the surgeon having previously surrounded the upper part of the limb obliquely with a cushion of wadding four fingers' breadth wide, and the length of the thigh-belt, or with the junk-bag, in order to moderate the pressure of the latter, and render it more supportable. The hollows of the sole of the foot and lower part of the leg are also filled up with wadding or tow, and the foot-piece is fastened to the former by means of the soft leather straps attached to its under surface, which pass round the lower part of the leg. Should, however, these straps appear insufficient to fix the iron sole firmly to the foot, an extra band of calico or linen may be applied in the same manner, Fig. 270.

Fig. 270.



"That done, the surgeon proceeds to the reduction of the fracture, and, after adapting the upper extremity of the splint to the pouch of the perineal band, the foot-support being connected with the splint, and the cushions and the anterior and internal splints applied, the whole is fixed by means of the tapes, as in the ordinary apparatus for fractures of the thigh. Lastly, by turning the winch, the iron sole is lowered, drawing the foot, to which it is attached, along with it; and the superior extremity of the splint being pushed upward, the member can be elongated to the necessary extent."

**Hartshorne's Splints.**—These are generally spoken of as a modification of Boyer's, but differ so much from them as to be almost entirely new. They are composed of an outer splint, long enough to reach from four inches below the heel nearly to the axilla; and of an inner splint, which goes from the same point up to the perineum. In the lower extremity of each of these is a long mortise in which the foot-board slides, or is moved by the screw. The upper end of the inner splint is covered with a pad of horse-hair, which is again covered by buckskin, Fig. 271. An ordinary gaiter and a handker-

Fig. 271.
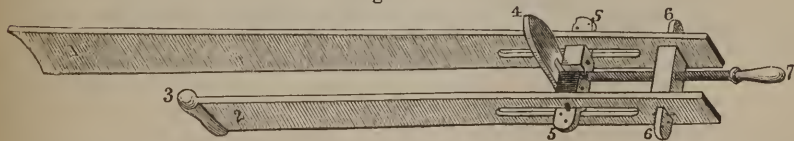


A VIEW OF HARTSHORNE'S SPLINT FOR FRACTURE OF THE SHAFT OF THE FEMUR.—1. Upper end of the outside splint. 2. The inside splint. 3. Its padded end, by which counter-extension is made. 4. The movable foot-board. 5, 5. Two movable tenons, to which the foot-board is attached. 6, 6. Two fixed tenons, in which a screw plays so as to approximate 5, 5. 7. The screw which passes through 6, 6 is fastened on 5, 5. (After Nature.)

chief complete the apparatus. In its application, fix the extending band to the leg as directed for extension, and pass the splints on each side of the

limb till the inner or padded one touches the perineum.   Then attach the tapes of the extending band to the upper block or foot-board, and by turning the screw draw it down, the limb following this movement till the perineum bears on the pad, when it is stopped, and the counter-extension made by means of the padded end of the inner splint, Fig. 272.

Fig. 272.
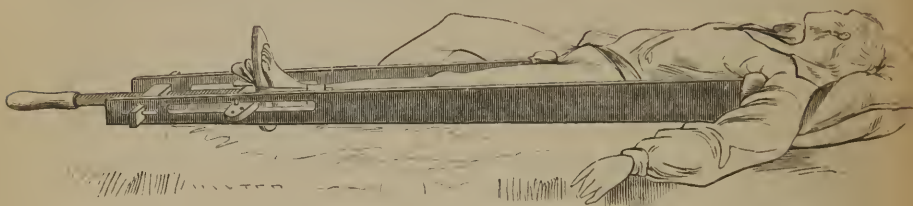


A side view of Hartshorne's Splint, as applied to the patient, the extension being made at the foot by fastening it to the foot-board and turning the screw, while the counter-extension is made by a pad on the upper end of the inside splint. The upper end of the outside splint is also represented as padded, but this is merely to protect the edge of the axilla, and has no connection with either the extension or counter-extension. In compound fractures this outside splint may be removed, and the wound dressed, without affecting the extension of the limb. (After Nature.)

Junk-bags may be placed between the splints and the side of the body and limb if they press too much against it, but generally this is not the case; and in cases of compound fracture, where they would be soiled by the discharges, it is desirable to omit them.   It is chiefly, I think, in cases of this kind, that these splints can be used to the greatest advantage, as the extension and counter-extension being kept up chiefly on the inner side, we can remove the outer splint, or cut out an oval piece corresponding with the wound, if on the outside of the thigh, and thus dress the wound, without taking off the extension.   Care must, however, be observed in the use of this splint, that the pressure upon the integuments of the perineum does not produce a slough.

When, from any cause, a different dressing seems desirable, resort may be had to the modification of the Dessault and Boyer's splints, suggested by the late Dr. Horner, of Philadelphia.

**Horner's Splint.**—This splint consists of two splints similar in length to those of Physick, but padded throughout their length, so as to supersede the necessity of junk-bags.   The outside splint is otherwise precisely like that of Physick, but the upper extremity of the inside splint is so shaped as to supersede the necessity of a perineal band, Fig. 273, being slightly carved out like a crutch-head and having stretched across it a soft leather strap.   On the inside of the upper portion of this splint two leather loops are nailed, to serve for the attachment of the counter-extending band.   This inside splint, therefore, makes the counter-extension by being drawn up against the perineum, pressure being thus made upon a different point from that which bore the counter-extending band in Physick's dressing.   The apparatus thus prepared is applied as follows : Four or five strips of bandage being laid down transversely on the bed, the patient should be placed on them—no splint cloth being required—and the splints laid one on each side of the limb, a piece of bandage being passed through the leather loops on the side and near the upper end of the inside splint, one portion of which should be carried beneath the buttock, while the other passes in the line of the groin to the top of the outside splint, where they are tied, so as to make the counter-extension.   Extension being then made by means of adhesive plaster, as already described, the bandage should be attached to the block

below the foot, and be made fast to the lower end of the outside splint, as
in the previous dressing. The counter-extension is thus made on the lower

Fig. 273.

A FRONT VIEW OF HORNER'S SPLINT.—
A. Bottom of outside splint. B, B. Block
for extending band to pass over, so as to
keep the extension in the line of the body.
C. Perforation for the passage of one end of
the extending band, which can thus be tied
on the bottom end of the splint at A. D. The
two perforations at the top of the splint,
through which the counter-extending bands
are to be passed. This splint is to be padded,
as shown in the cut, so as to do away with
the junk-bags. E. Excavation of upper end
of inside splint. F. Strip of leather stretched
across it, to serve as the point of counter-
extension. G, G. In the magnified view of
the upper end of the inside splint are the
two loops of leather, as tacked to the outer
side of the inner splint to receive the coun-
ter-extending tape. H, H. The tape or band-
age as passed through these loops. The
width of this tape is of no consequence if it
is strong enough, as it does not press on the
body; the only point pressed on being the
perineum, and here the pressure is made by
the soft leather, which is stretched across
the excavated end of the inside splint. Phy-
sick's Splint may, therefore, be readily con-
verted into Horner's, when it is desired to
vary the seat of pressure from the counter-
extending band. (After Nature.)
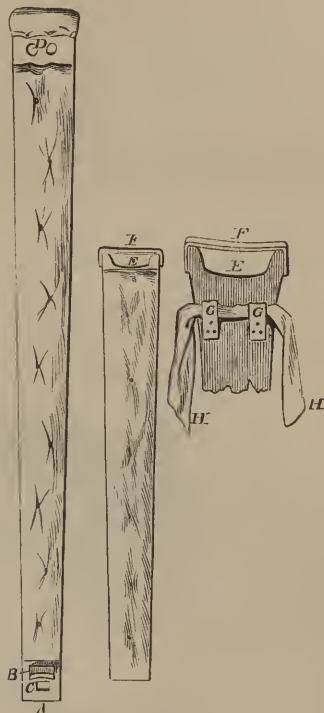


part of the perineum by means of the loops fastened near the inner side of
the inside splint acting on the strap stretched across the upper end of this

Fig. 274.
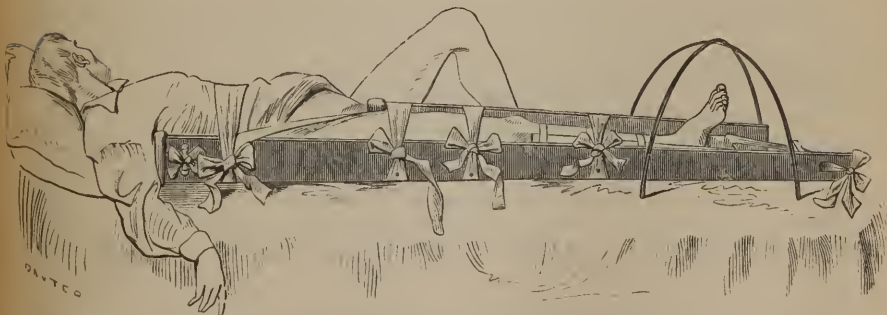


A side view of Horner's Splint, as applied to the patient. As the cross strips are tacked fast to the splints,
as represented by the black dots in the figure, they act in supporting the splints laterally against the limb
with much greater certainty than the splint cloth of Dessault, this being liable to slip, and also difficult to
apply so as to obtain the proper width for the limb between the splints. (After Nature.)

same splint, while the extension is made in the middle line of the limb, as
in Physick's splint. The dressing is completed by tying the strips of band-

age, previously laid on the bed, around the two splints, and fastening each strip to the two splints by means of a carpet tack, which firmly secures them to the limb and obviates the necessity for a splint cloth. This dressing is particularly adapted to cases in which ulceration has resulted from the use of other apparatus.

**Hodge's Splint.**—Lennox Hodge, of Philadelphia, has modified Physick's long splint* by attaching to it, by means of bolts or screws, a bar of wrought-iron, bent—as shown in the figure—to the right or left, in accordance with the side to which it is to be applied, the splint being wide enough to enable the bar to pass clear of the patient's shoulder and arm. Then, with adhesive plaster strips, for extension and for counter-extension, applied according to his method, p. 621, an excellent means of treating this fracture, especially

Fig. 275.
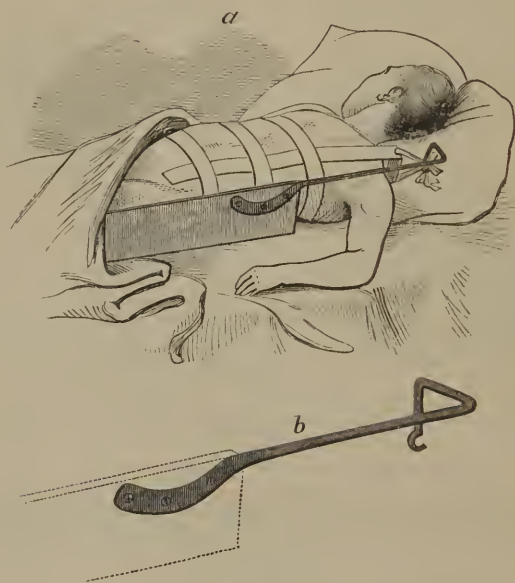


A VIEW OF HODGE'S SPLINT.—*b*. The counter-extending bar as attached to the long splint.

in hospitals, is furnished, Fig. 275. For general use it is not so applicable as Physick's, as it is not so readily made at any locality where wood is to be obtained, but when obtainable is a superior dressing from the perfection of the mode and line of the extending and counter-extending straps.

**Amesbury's Apparatus for Fractures of the Middle and Lower Third of the Femur** "is divided into three portions, independent of splints and straps: one is for the thigh, *a*, Fig. 276; another for the leg, *b*; and the third for the foot, *c*. There are two thigh-pieces made to each apparatus, one of which is beveled off at the lower end to the right, and the other to the left; so that when one of them is fixed to the leg-piece, which is hollowed out to receive the back of the leg, the leg and thigh-piece together are adapted to the natural line of the right limb; and when the other thigh-piece is joined to the leg-piece, they are adapted to the natural line of the

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* Am. Jour. Med. Sciences, April, 1860.

left limb. This arrangement Amesbury considers necessary, in order to preserve the figure of a perfectly formed limb, which is not straight, but turns inward a little at the knee. The leg and thigh portions are connected by means of a little steel or brass pin, *d*. Behind the apparatus is a steel bar, *e*, coated with brass, and fixed to the back of the leg-piece. To the upper end of this bar is fixed what Amesbury calls a brass foot, to which is attached a bolt acted upon by a spring. There is a hole in the centre of this brass foot, which is traversed by the bolt in the transverse direction.

Fig. 276.
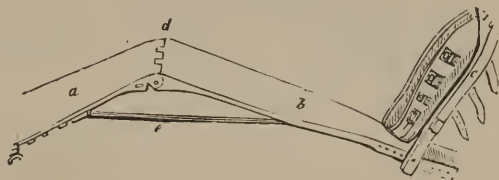


At the back of each thigh-piece is a rack, *g*, Fig. 276, with several projections, each having a hole bored through the middle, for the purpose of receiving the bolt attached to the brass foot-piece. The foot-piece is so connected with the steel bar that it may be easily fixed upon any of these projections. When fixed upon either of these, except that nearest the leg-piece, the leg and thigh-pieces become joined together, so as to form a double inclined plane, Fig. 276, the angle of which may be varied at pleasure by altering the position of the brass foot-piece from one of the teeth or projections of the rack to another. At the upper end of the thigh-piece is a sliding brass plate, *h*, Fig. 277, so adapted that it may be applied to either

Fig. 277.
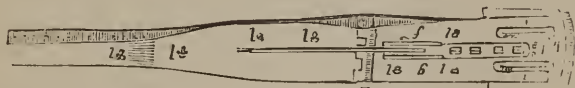


of the thigh-pieces at pleasure. This contrivance allows of the thigh part of the apparatus being adapted to thighs of various lengths. The upper end of this plate is turned off, so that, when it is properly padded, it may bear against the tuberosity of the ischium without injuring the integuments. At the back of the sliding-plate are placed a couple of brass bars, *i i*, which answer the double purpose of rendering the sliding-plate more secure when it is fixed upon the thigh-piece, and of preventing the pelvic strap, to be noticed presently, from slipping off the apparatus. There are little studs, *l*, placed at the back of the apparatus, for the purpose of receiving the straps by which it is confined to the limb.

"The pelvic strap is of leather, furnished with a sliding pad, and sufficiently long to reach round the thigh and the pelvis.

"Three short splints, long enough to reach from the upper end of the thigh to the lower part of the condyles of the femur, are also required to be placed upon the thigh.

"**Application.**—The apparatus and splints being properly padded, the surgeon places the pelvic strap between the bars and the plate or sliding portion; taking care previously to apply a single-headed roller, *d*, as in the

cut, spirally about the leg, from the toes to the knee.    This being done, an
assistant takes the small of the leg in one hand, places the other under the
knee to raise the limb, and at the same time to keep the knee bent and the
thigh extended, while the surgeon places the apparatus under it.    When
the limb is properly placed, the shoe, *a*, Fig. 278, previously padded in the

Fig. 278.
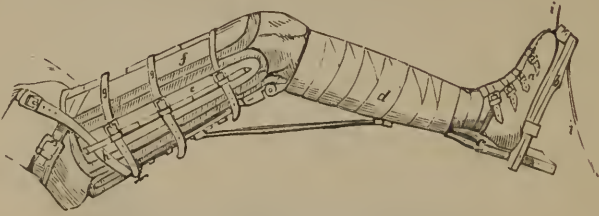


inside, is buckled to the foot, while the foot-board, *b*, and leg-piece are placed
at nearly right angles, in order to give the foot support and steadiness.
The leg is then supported along the whole of its under surface, in order to
give it an equal bearing upon every point of the apparatus, and this is done
by means of tow or wadding, *c*, placed under the small of the leg, between
the long pad and the leg-piece.    The leg is then fixed upon the apparatus
by a roller carried spirally round both from the angle to the bend of the
knee, or by straps properly padded.    To confine the fractured parts in their
natural position, the assistant takes the apparatus and the knee between his
hands, and extends the thigh gradually in a line with the thigh part of the
apparatus, which the surgeon supports against the back of the limb.    Then,
after coaptating the fragments of the bone, he applies the splints : the first,
*e*, on the outer side of the thigh, from the great trochanter to the lower part
of the outer condyle ; the second, on its inner side, reaching from the pubes
to the lower part of the inner condyle ; and the third, *f*, upon the fore part
of the thigh, from a little below the superior anterior spinous process of the
ilium to the base of the patella.    These splints are kept in place by the
straps, *g g g*, fixed to the studs on the back part of the apparatus.    Lastly,
the pelvic strap, *h*, is to be carried round the limb, under the strips of leather
of the splints, and made to cross on the outer side, while the buckle-end,
with the sliding pad, is carried round the pelvis and made to meet the other
end in front, where it should be fastened.    The tapes, *i i*, serve for fixing
the lower part of the apparatus to the foot of the bed." This and others of
Mr. Amesbury's apparatus are thought by him to offer peculiar advantages;
and, as he has written two large octavo volumes on the subject of Fractures,
I would refer those desirous of learning his views more fully, to the work
itself.

The above account of Amesbury's splint is given as part of the history of
the treatment of fractures of the femur.

Several splints, very similar in principle to those of Amesbury, are now
manufactured to a considerable extent as original, in some of the New
England States, and circulated all over the country.    As a general rule,
they are objectionable, from their complicated character, and, like those of
Amesbury, can only be prepared by the manufacturer ; while those equally
as good can be made by any carpenter, after the pattern of Physick, Harts-
horne, and Horner.

Gibson's Simple Inclined Plane is composed of a board sixteen inches
wide, two feet four inches high, and with six mortises near its upper extrem-

ity, which is placed vertically; another board, of similar breadth and length, is placed horizontally; and a third, three feet long, and extending from the extremity of the horizontal one to within ten inches of the top of the upright one, forms an inclined plane; the whole joined together, forming a triangle, Fig. 279.

Fig. 279.
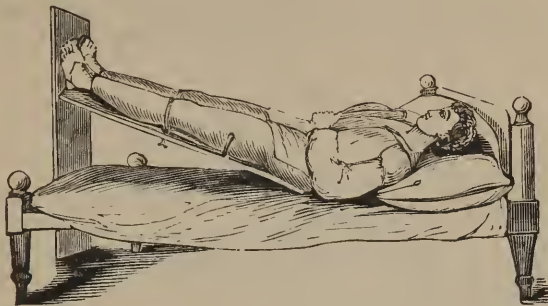


At the lower end of the inclined board is an opening six inches wide and eight long, to allow of the passage of feces and urine to a vessel below. There are likewise two mattresses, two foot-cushions, and a pair of gaiters. The larger mattress, of the length and breadth of the inclined board, is two and a half inches thick, and fastened to the board by straps on its edges. The smaller mattress fills up the opening for the passage of feces, etc. Lastly, there are two round pins, each six inches long, which are passed through holes in the inclined plane. Then, the patient being placed on this, as seen in Fig. 279, and the extension made along the legs by adhesive strips, the fastening of the feet to the upright makes the extension, and the weight of the body the counter-extension, thus placing the limbs in an easy position; in one very favorable to the reduction of any inflammation, and especially applicable to the cases of fracture of both thighs, just mentioned. The modification of Hagedorn's splint, by the same surgeon, renders it so difficult to give the patient a stool—both thighs being confined—or to use a urinal, or to prevent bed-sores, that I regard its use as often productive of serious trouble, and therefore omit further reference to it.

When, from peculiar circumstances, we wish to allow a certain degree of

Fig. 280.
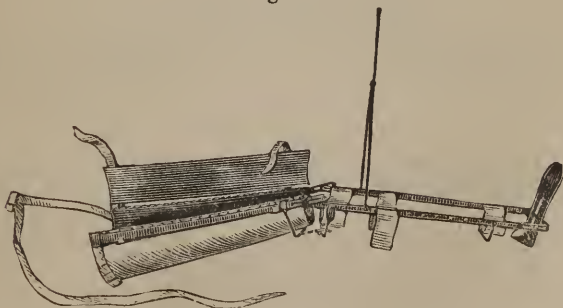


motion to the limb, we may find it useful to employ the apparatus of Nathan R. Smith, of Baltimore. "This consists of four pieces, viz.: two concave

inclined planes, one of which is adapted to the inferior surface of the thigh, the other to that of the leg, and united by a hinge corresponding with the knee. The third piece is for the foot, and the fourth, connected to the thigh-piece, extends up the side of the body, Fig. 280. The limb being placed in it, as in Fig. 281, is then to be suspended." It is, however, a somewhat complicated apparatus, or at least one which, like some of the splints before mentioned, is not readily prepared at the moment. When applied, it makes, however, a very light and excellent double inclined plane. The figures give a good idea of it, and those who may wish to construct one

Fig. 281.
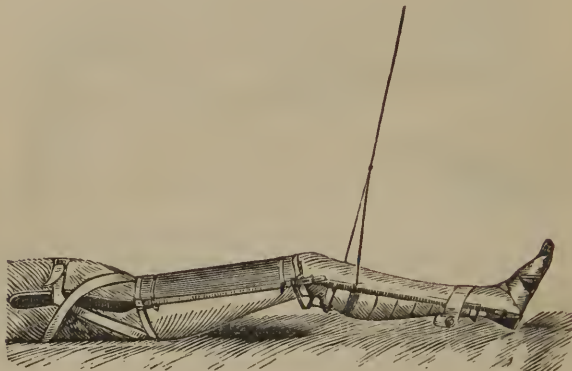


will find a minute account of it, in all its parts, in *Gedding's Baltimore Med. and Surg. Journal*, vol. i., 1833, and in the *Transactions of the American National Medical Association*, vol. ii., 1849.

An anterior wire splint, Fig. 282, with suspension, Fig. 283, on the plan

Fig. 282.
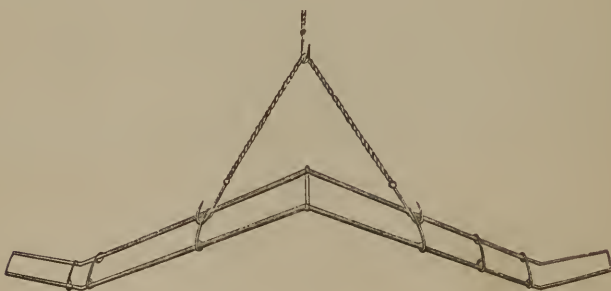


of Mayor, of Lausanne, has been also suggested* by the same surgeon, of which the drawings give a full explanation. The suggestion is yet too recent to have permitted its being freely tested. The extension and counter-extension are here made as in the double inclined plane, described in connection with fracture of the neck of the femur, p. 614.

When, in fractures of the upper third of the shaft, difficulty is experienced in bringing down to a proper anterior line the lower end of the upper frag-

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* Maryland and Virginia Med. Jour., Jan. 1860.

ment—or when the accident is so complicated that extension and counter-extension cannot be made by any of the plans before suggested—the double

Fig. 283.
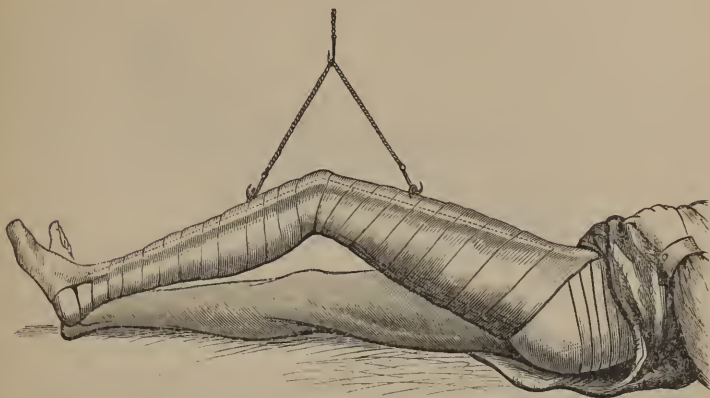


inclined plane, as shown in Fig. 258, may be advantageously resorted to; the flexion of the knee in this apparatus making the extension when the foot is attached to the foot-board, and the weight of the body making the counter-extension.

Were other evidence wanting, the variety of forms of apparatus suggested by different surgeons, and of which I have only enumerated a portion—espe-cially those suggested by American surgeons, and easily made anywhere—would be sufficient to show the difficulties often encountered in the treatment of this fracture. Experience having shown me that sometimes in the same patient one or more forms of apparatus may be demanded to accomplish a good cure, their enumeration has been deemed worthy of the details as well as space now given to them.

**Fracture of the Condyles of the Femur.**—When a fracture of the femur occurs through the condyles, an injury is produced which involves the knee-joint, and which, therefore, besides the dangers incident to fracture, exposes the patient to all those likely to result from the inflammation of so important an articulation. (See ACUTE ARTHRITIS.)

**Symptoms.**—The symptoms of this fracture are generally quite marked; thus, there is increased width of the joint, with great pain and swelling, crepitus, as a general rule, being readily perceptible.

**Prognosis.**—As there is usually prompt effusion into the joint, the acci-dent, if the patient recovers without amputation, can hardly result in anything but anchylosis, or at least in an imperfect limb.

**Treatment.**—In the treatment of this fracture the remedies should be addressed rather to the prevention of inflammation in the joint than to the mere injury of the bone, extension and counter-extension not being de-manded, nor can they often be borne. A long fracture-box, long enough to reach from the foot to above the middle of the thigh, Fig. 284, should, therefore, be selected, a pillow placed upon it, and the limb laid on the pillow, when, the sides of the box being brought together, pressure can be made, and the parts kept at rest, while leeches, cold cloths, lead-water, etc., are applied to check the rising inflammation.

After continuing this treatment for several weeks, or until the inflamma-tory action has diminished, a carved splint or trough should be well padded

and retained to the limb by a bandage, passive motion being subsequently gently tried, in order to limit the extent of the anchylosis.   All motion in

Fig. 284.
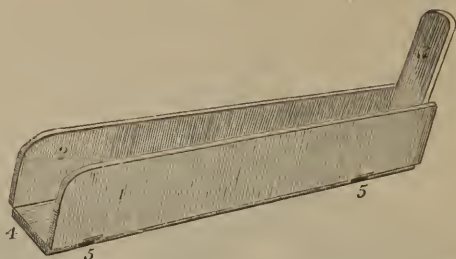


A SIDE VIEW OF THE LONG FRACTURE-BOX FOR THE TREATMENT OF INJURIES OF THE KNEE-JOINT.—1. Outer side. 2. Inner side. 3. The foot-board. 4. Bottom piece. 5, 5. Hinges which attach the side pieces to the bottom and enable them to shut against the sides of the foot-board, thus making lateral pressure on the limb when placed within the box on a pillow. (After Nature.)

the knee after this fracture should, however, be commenced very carefully, the joint being flexed at first only half an inch or so from its position and set down again; when, in a day or two, it may be flexed a little more.

**Compound fracture** of the condyles of the femur is best treated by means of a fracture-box prepared as for Dr. Rhea Barton's bran dressing, the mode of employing which will be described in connection with compound fractures of the leg, but almost invariably ends in amputation of the limb, as will be seen hereafter.

## SECTION II.

### FRACTURES OF THE PATELLA.

**Fracture of the Patella** resembles greatly fracture of the olecranon in the causes of the displacement of the fragments, the subsequent effects of the fracture and weakness of the limb, as well as in the indications to be fulfilled in its treatment.

**Anatomical Relations.**—The patella is so situated that it is between two forces, one of which possesses great power, its attachment by the ligament of the patella to the tuberosity of the tibia holding it firmly below, while superiorly it is acted on by the tendon of the quadriceps femoris, a muscle of considerable magnitude.   The tendon of this muscle being continued over and around the patella, unites at its inferior edge with the ligament as it passes toward its insertion into the tibia, the bone being thus made to act the part of a sesamoid bone and facilitate the play of the tendon over the condyles of the femur and the knee-joint.   The periosteal covering is, therefore, imperfect.

**Etiology.**—The patella is liable to fracture, not only from external forces, but also from muscular action, the contractions of the quadriceps femoris muscle becoming, under certain circumstances, so powerful that the tendinous expansion over the face of the bone gives way, and the bone is fairly torn in half, the upper fragment being carried up toward the lower fifth of the shaft of the femur, Fig. 285, *B*.

**Patients.**—The class of individuals who suffer from this accident are, therefore, those who, from their calling, are in the habit of making violent

muscular contractions of the lower extremities, such as ballet or tight-rope dancers, or circus-riders, in whom it sometimes occurs while in the act of leaping.

This fracture is also sometimes produced by mechanical violence, as when a person falls with his knee upon some sharp substance that cuts through the patella, the force being thus applied directly to the bone.

However produced, this fracture, like that of the olecranon, diminishes to some extent the usefulness of the limb, bony union seldom occurring, the fragments, like those of the olecranon, being generally united by a ligamentous band which, though ultimately very firm, yet destroys more or less of the power of the muscles inserted into the patella by adding to their length.

In this, as well as in every fracture in the neighborhood of a joint, the inflammation set up by the fracture, or caused directly by the injury, may also extend itself to the joint, synovitis and partial anchylosis sometimes complicating the injury.

Fig. 285.
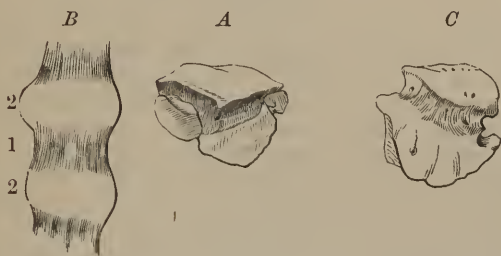


A VIEW OF THE CONDITION OF THE PATELLA AFTER A FRACTURE.—A. An oblique comminuted fracture of the patella. B. A transverse fracture showing the union by ligamentous matter, and the manner in which it adds to the length of the quadriceps femoris muscle and thus diminishes its power. 1. Intervening ligament between the fragments. 2, 2. The upper and lower fragments. C represents a case of osseous union of the patella. (After Nature.)

**Symptoms.**—When a fracture of the patella occurs, the following train of symptoms supervene: If the patient is in the erect position at the time of the occurrence, especially in those cases in which the bone is broken by muscular violence, he drops to the ground suddenly, as if he had been shot, and finds himself unable to rise upon his feet. Soon afterward a considerable amount of swelling will be observed about the knee, and, as the fracture is generally transverse, an apparent increased length of the patella can be noticed. When the fingers are passed along the sides of the fragment, a deficiency in the correct outline of the bone will also be observed, and, if the swelling has not become too great, the fingers can depress the front of the soft parts between the two fragments, and thus show distinctly the nature of the case; but crepitus cannot be made unless by drawing down the upper fragment in contact with the lower, which is almost impossible. Some modifications of these symptoms will, however, sometimes occur, owing to circumstances; thus, if the fracture is oblique, there will be a difference in the character of the deformity, and crepitus may be made; while, if the tendinous expansion over the bone be not entirely ruptured, the separation between the fragments will not be as marked as if it had happened.

**Diagnosis.**—When there is much swelling, the diagnosis of this fracture may be difficult at first, but generally the mobility of the upper fragment establishes the character of the injury.

**Prognosis.**—The result of a simple fracture of the patella is favorable, as regards the ability to walk, though there is often some slight loss of power

in the extension of the leg, the union of the fragments, as before stated, being so generally fibrous that the possibility of osseous union has been denied. Several cases of osseous union have, however, been met with, and there is in my cabinet a specimen, the history of which is unknown, in which the union is very complete, Fig. 285, *C.* The fact that such union may occur renders it, therefore, exceedingly important that, in the treatment of these cases, the fragments should be kept accurately adjusted, so as to present the most favorable circumstances for this desirable termination, or, if the surgeon fail in procuring osseous union, that such an apposition of the fragments may at least cause the fibrous band between them to be as short as possible.

Treatment.—The treatment in fractures of the patella, as in fractures of the olecranon, will consist in keeping the limb at rest in the extended position, and in the use of such apparatus as can retain the fragments in position, and is calculated to counteract the power of the muscles which act in separating the fragments. This apparatus may consist in any of the following dressings:—

That of *Dessault* for fractured patella is applied as follows: Take a strip of muslin, two and a half inches wide and long enough to go from the ankle to the groin, and lay it along the front of the limb; then, commencing at the ankle, bind it in position by the ordinary spiral bandage of the lower extremity, covering in the heel lest the swelling which may ensue from the compression of the skin should predispose that point to take on ulcerative action. After covering the heel, continue the turns of the roller regularly up the limb until the knee is reached; when two slits should be cut in the band first laid upon the front of the limb in such a manner as to permit the surgeon's fingers to pass through and draw the upper fragment down. Then, retaining the fragments in apposition, cover in the knee with the ordinary figure of 8 turns so as to bind the upper and lower fragments in nearly accurate juxtaposition, and fastening this roller with a pin, take another roller and proceed with the ordinary spiral reversed turns to cover in the thigh, drawing these turns with considerable firmness in order to prevent the contraction of the great muscles which act upon the upper fragment. After fastening the end of this bandage with a pin, the dressing is to be completed by the application of a straight splint on the back of the limb long enough to reach from the tuber ischii to the heel, the entire splint being carefully padded, especially under the heel and knee. The limb may now be elevated upon a single inclined plane, Fig. 286, of sufficient length to flex the femur upon the pelvis and thus diminish still further the power of the muscles upon the front of the thigh. Besides which, this inclined plane, by elevating the limb and draining it of blood, does away with the tendency toward inflammation which might ensue upon the application of the roller or the cause producing the injury.

Fig. 286.



A side view of the simple inclined plan for elevating the lower extremity. (After Nature.)

Another dressing is that of *Boyer* for fracture of the olecranon, which is equally adapted to fracture of the patella, and is as follows: Having applied the ordinary spiral bandage of the lower extremity, and carried it up as high as the knee, a long compress of muslin should be folded, and applied

in the form of a figure of 8, so as to draw the upper fragment down, after which the fragments should be held in position by another bandage, which, commencing at the knee and covering in the joint by figure of 8 turns, should be carried to the groin, a long splint being applied to the back of the limb, precisely as was done in Dessault's dressing.

Another dressing, by means of which a considerable amount of power can be obtained, and one which can generally be made upon the spur of the moment, is that of *Dorsey*, formerly Professor of Surgery in the University of Pennsylvania. It consists of a straight splint for the back of the limb, long enough to go from the tuberosity of the ischium to the heel, upon which two strips of bandage are nailed with carpet tacks, one a little above and the other a little below a point corresponding with the back of the knee-joint. Then, the splint being carefully padded and a bandage applied to the limb, from the toes to the groin, place the splint on the back of the limb, and carry the upper strip, 1, 1, Fig. 287, as attached to the splint, round the knee so as to tie on a compress below the lower fragment, while the lower strip, 2, 2, Fig. 287, is in like manner to be carried round and tied on a compress above the upper fragment. These two strips, thus acting on the compresses, will hold the fragments accurately in position, while the splint will keep the limb extended and prevent the contraction of the muscles. After arranging these, bandage the leg fast to the splint by the ordinary spiral bandage of the lower extremities. This dressing is one of very great power, and in some cases will be very well borne, but in the early stages of the majority of cases its employment would expose the patient to great risk of inflammation and ulceration.

Fig. 287.



A VIEW OF THE MIDDLE PORTION OF THE SPLINT AS ARRANGED BY DORSEY FOR THE TREATMENT OF FRACTURE OF THE PATELLA.—1, 1. The lower strip nailed on to the splint so that it can be carried over a compress which is to be placed *above* the upper fragment. 2, 2. A similar strip as arranged to pass *below* the lower fragment. (After Nature.)

There is perhaps only one mode by which the fracture can be kept more thoroughly in position than by this apparatus of Dorsey, and that is the plan of Malgaigne, which consists of two little hooked iron clamps that he inserts through the skin into the tendon, and, approximating the fragments by drawing upon the plates, fastens them by means of a screw; a method that has, in one case out of four, been followed by bony union. It is, however, a plan which, from personal observation, seems objectionable not only from its being difficult to apply the hooks accurately without perforating the joint, but from the liability to erysipelas.

The same apparatus, which was described as Astley Cooper's apparatus for fracture of the olecranon, may also, with very trifling modification, be adapted to fractures of the patella, and its application need not, therefore, be repeated in this place. As the inflammatory swelling that supervenes on this fracture often prevents the immediate application of a bandage, strips of adhesive plaster carried obliquely around the knee above and below the upper and lower fragments are sometimes the only dressing that can be employed. Very excellent cures are also obtained in this way by the addition of a splint and a bandage judiciously applied as first advised by Dessault, and the combination of the two is now often resorted to under various modifications, and is, I think, the best plan of treatment.

In this dressing cut the sticking-plaster into strips about three-quarters of an inch wide and long enough to pass obliquely around the limb and overlap a little; then, fixing the lower fragment, apply the first strip, carrying it from behind the head of the tibia around the lower point of the patella upward, to terminate behind on a level with the upper part of the condyles of the femur, continuing to apply similar strips, so that each shall slightly overlap the preceding strip until the middle of the knee is reached, each strip gradually becoming more circular in its course to the middle of the joint. Then, drawing down as firmly as possible the upper fragment, retain it in position by strips similarly applied in the reverse direction and overlapping each other, passing from behind the head of the tibia obliquely up over the upper fragment and down and back to the point behind the head of the fibula, thus forming two semicircles of plaster, the circumference of one embracing the upper, and that of the other the lower fragment; then apply a padded splint to the back of the limb, extending from the tuberosity of the ischium to the heel, bind it lightly to the limb, seeing that the heel and popliteal region are both well supported by padding, and place it on an inclined plane, as made by a chair turned back down, or by a plank, pillows, etc.

This dressing may be retained for a week or more, unless evidently loosened, when it should be taken off and reapplied, the fragments being carefully held in position by an assistant during the change. It should be continued for five or six weeks, passive motion or flexion of the joint being cautiously made after the first three weeks. In the Pennsylvania Hospital, of Philadelphia, this dressing, which was some thirty years since employed by Barton and others of Philadelphia, has been frequently applied to simple fracture of the patella with satisfactory results—attention having been recalled to it by Neill, of Philadelphia. Gama, of the Val de Grace, Alcock, of England, and Hamilton, of New York, all bear testimony to the value of this dressing, though each has slightly modified the splint, while retaining the use of the strips.

Fig. 288.



Another dressing, always obtainable but liable to cause pain, etc., if too early applied, is the uniting bandage of *Gerdy*. In this dressing two strips of muslin about two and a half inches wide are prepared by making three slits in one and tearing the end of the other into three tails; then, the ordinary spiral bandage being applied to the leg and thigh, but without covering in the knee, the first piece of muslin is to be laid so that the slits will correspond with the edge of the lower fragment, when it should be bound upon the leg by the circular turns of a roller applied below the knee. The piece with the tails being then laid upon the front of the thigh, should be fastened in like manner above the upper fragment by the spiral turns of a roller, which commences above the knee and extends to the groin. Two compresses being then placed one below the lower fragment, and one above the upper, the tails should be passed through the slits, and the two fragments be closely approximated. After which the whole limb should be bandaged with a second spiral roller, the object of which is to fasten the strips and retain the uniting bandage in its position, Fig. 288.

The after-treatment and general directions of this dressing are the same as those stated in connection with the others.

As a temporary dressing, **Mayor's method,** as already mentioned under his system as the tarso-patellæ handkerchief, may be applied.

**After-Treatment.**—When the patient commences to walk about he often desires artificial support of the fragments for some weeks, or until he gains confidence in the limb, and a neat and convenient apparatus is now made by the cutlers, for this purpose, that is often useful. It consists of a piece of padded leather which buckles round the limb above and below the fragments, and the two parts being approximated by means of straps, the fragments are held accurately adjusted. Such a dressing is very neat, well suited to the better class of patients, and particularly adapted to those persons who are obliged to travel after a fracture of the patella before the bond of union is sufficiently firm to justify the omission of all dressings.

## SECTION III.

### FRACTURES OF THE BONES OF THE LEG.

The **Bones of the Leg** may be broken at any part of their length, the accident being sufficiently common. A fracture high up through the tubercle of the tibia sometimes occurs, and is very serious, not only because it is liable to involve the knee-joint, but also because it is apt to be followed by gangrene of the integuments, the latter being due to injury of the branches of the tibial artery. When both bones of the leg are broken, it rarely happens that the fracture occurs at the same point in both; thus, if a fracture of the tibia has occurred at the junction of the middle and lower third of the bone, the fracture of the fibula accompanying it will be apt to happen at the junction of the middle and upper third of the bone, and *vice versa*. Still it sometimes occurs, as when a person has been run over by a wagon or railroad car, that both bones are broken in the same line.

Fractures of the bones of the leg may be transverse or oblique, simple, compound, or comminuted.

**Displacement.**—Various deformities result from these fractures, which differ in accordance with the character of the force producing the injury, and with the point at which the fracture occurs. Perhaps the most common is a disposition in the upper part of the lower fragment to project forward (see Fig. 289) the gastrocnemius and soleus muscles, which are inserted into the os calcis, contracting so as to approximate the heel to the back of the thigh, in consequence of which the foot is pulled backward, and the upper end of the lower fragment thrown forward. Shortening, when it exists, is generally due to the action of the extensor muscles; it is, however, seldom marked in these fractures, on account of the insertion of the interosseous ligament. The angular deformity, it should be remembered, is more

Fig. 289.



A side view of the angular deformity of the tibia, often seen after fractures of the leg, showing the action of the gastrocnemius and soleus muscles. The drawing also shows the action of the quadriceps femoris muscle in producing a separation of the fragments in a fracture of the patella. (After Hines.)

marked when the fracture is transverse than when it is oblique.  In an oblique fracture, although the deformity is not so great as in a transverse one, the lateral deviation is greater, and there is risk of the fragments wounding the anterior or posterior tibial artery or veins, and thus causing tumefaction, etc., from external and concealed hemorrhage, the lividity in some cases being very marked from absorption of the blood.    Sometimes, when great force has been used, the fragments become impacted, or they may be so driven through the skin as to cause a compound fracture.    There is still another displacement, which must be guarded against in the treat- ment of fracture of both bones of the leg, and that is a displacement in the circumference of the limb, as shown by a rotation of the foot causing the toes to turn inward or outward, though most frequently the latter.    In fracture of either the tibia or fibula alone, there is generally little or no dis- placement, the unbroken bone acting as a splint to support the injured one, so that there can be no shortening of the limb.

**Diagnosis.**—The diagnosis of fracture of the leg is usually easy.

**Prognosis.**—With care and attention a simple fracture of both bones of the leg usually recovers without such deviation as creates a limp, sometimes without perceptible deformity, except that temporarily caused by the callus.

**Treatment.**—The means by which the indications which should be ful- filled in fractures of these bones are to be carried out are various.    In hos- pital practice, and in the army and navy, where the patient can be controlled, perhaps the best means of treating them is by the fracture-box, Fig. 290, but it is a mode of treatment against which patients in the better ranks of life will often rebel.    It is also often complained of in consequence of the pressure of the point of the heel against the bottom of the box, causing pain and ulceration, even when the heel is well supported by a pillow.

The fracture-box is made by cutting a piece of board, a little wider than the limb, of such a length that it will reach from the sole of the foot to the knee, and a foot-board should be attached to its inferior extremity at right angles—not obliquely, as is sometimes done, as this elevates the heel, and consequently does not allow of the accurate reduction of the displace- ment, the box being then completed by two side pieces, which are fastened on to the bottom by hinges or by strips of leather.

Fig. 290.
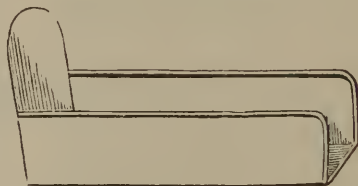


A representation of the Fracture-box for the treatment of one or both bones of the leg.  (After Nature.)

In applying this apparatus, two strips of bandage of sufficient length should be laid on the bed transversely to the length of the limb.    On these the box should be placed and a pillow laid in the box.    The limb being then laid upon the pillow, and a proper degree of extension and counter-exten- sion made by the hands of the surgeon, the foot should be fastened to the foot-board by the simple turn of a roller, the sides of the box closed upon the pillow, and then tied so as to make lateral pressure on the limb. If the inflammatory action of the soft parts runs high, leeches, cold cloths, or cloths wrung out of lead-water, etc., can conveniently be applied without removing the dressings, though in this case the pillow should be

protected with a piece of oiled silk.    This treatment may be continued during the first eight or ten days after the accident, after which it becomes necessary to pay special attention to the line of the limb with reference to any deviation of the fragments.    Lymph is now beginning to be effused, and organization to take place around the seat of fracture, and it becomes therefore a matter of importance that the union should be accomplished in such a manner as will give the patient a limb that will correspond in shape with that upon the other side of his body, and thus enable him to walk with as much facility after as he did before the accident.

Fig. 291.



Thus, if the patient is bow-legged, the surgeon should not treat the injured limb in such a manner that when united it will be perfectly straight, as this would make the deformity in the other leg apparent, and interfere with the patient's gait.    A very good rule for telling whether the foot has been brought properly into line, even without examining the limb on the opposite side, is to notice that the inner side of the ball of the great toe is in a line with the inner side of the head of the tibia.    If this is the case, the surgeon can say with great confidence that the limb will be in its normal line.

If in making the dressings at this period a tendency is noticed in the heel to sink down, or for the upper end of the lower fragment to project forward, as in Fig. 289, a pad of cotton, or some similar substance, should be placed under the heel, but beneath the pillow, to prevent it.    If the toes have a tendency to fall inward, it may be counteracted by tying a piece of bandage around them, drawing them outward as much as necessary, and fastening the strip with a pin to the side of the pillow.

Although the fracture-box is a good dressing for the treatment of fracture of the leg, when the patient is entirely under the surgeon's control, as in the instances above alluded to, yet its usefulness will be found to be very much impaired when it comes to be applied to the limbs of those in the better condition of society.    These individuals, being more or less accustomed to independence of action, often fail to give to the commands of the surgeon that prompt obedience which can be exacted in the wards of a hospital, but have their heads propped up with pillows until they commence to slip down, owing to their being thus placed, as it were, on an inclined plane.    As the weight of the fracture-box retains the foot in position, the upper fragment is therefore pushed past the lower, and shortening is readily induced.    Or, if the pressure of the apparatus proves uncomfortable, and produces pain, the whole will be loosened by a friend, and tied up again in such a manner that its utility is destroyed.    For this class of patients, therefore, another mode of dressing becomes desirable, and resort may be had to the beautiful apparatus of Salter, of England, now obtainable at our cutlers.

**Salter's Apparatus** consists of a tin splint hollowed out at its inferior extremity, to receive the heel without making pressure upon it. This splint reposes in a sling attached to wheels which play up and down the centre-piece of an iron cradle, somewhat similar to that sometimes used to prevent the weight of the bedclothes from pressing upon the toes, and enables the

Fig. 292.
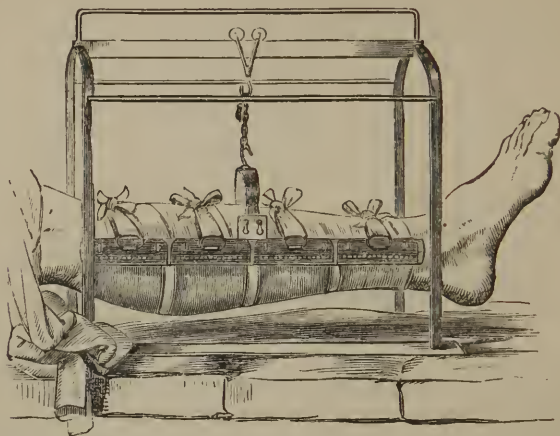


A view of Salter's apparatus for the treatment of fracture of both bones of the leg. The limb being bandaged, and a carved or tin splint applied beneath the calf, the whole should be placed in the sling, which, being attached to a little wheel that runs on the centre bar in the top of the frame, the sling moves with the motion of the patient; the latter being able to move the limb up and down with the motion of his body without deranging the fragments. (After Fergusson.)

patient to sit up or lie down in bed without displacing the fragments, as there is no point of resistance connected with the foot which can create shortening. The heel also is not pressed on, and the patient is thus saved a great source of annoyance. The lightness of the bandage which surrounds the limb will usually be well borne by patients in good circumstances, as in the accidents of the better classes of society we have seldom those extensive and terrible injuries to the soft parts which are met with among the laboring classes. A laboring man has his leg broken by being crushed under a gravel bank, while the gentleman breaks his by slipping and falling down upon the ice; and it is to such injuries as the latter, that is, injuries unaccompanied by severe contusion or laceration of the soft parts, that Salter's apparatus is particularly applicable.

But in the treatment of contused cases of fracture, the limb should be simply laid upon a pillow for the first few days and supported by light turns of a roller, the foot being steadied by a band fastened to the pillow. When inflammation has subsided, extension and counter-extension to the requisite degree may be made, the spiral of the lower extremity loosely applied, the tin splint padded and laid upon the back of the limb, and then retained by a bandage, when it may be laid in the sling of Salter's apparatus, the patient being no longer obliged to confine himself to one position. He may therefore move about in bed to a reasonable degree, or even sit up, the sling sliding along on its rollers, and adapting the position of the limb to the motion of the body, so that no danger of displacement is incurred. Salter's apparatus is, therefore, a neat and convenient dressing for such cases, being very useful where expense is not an object, and highly lauded for its comfort by those to whom I have applied it. Where, however, it cannot be obtained, and

some simpler dressing is desirable, its place may easily be supplied by a ruder contrivance of wood.

Another very excellent mode of treatment is by means of the old dressing of Boyer. This is applied as follows: Three strips of bandage are laid down transversely to the course of the limb, precisely as the two strips were laid down in the dressing with the fracture-box. Upon these should be laid a splint cloth of appropriate dimensions, say half a yard by a yard; on the splint cloth a pillow, and upon the pillow an 18-tailed bandage. (See page 622.)

Fig. 293.
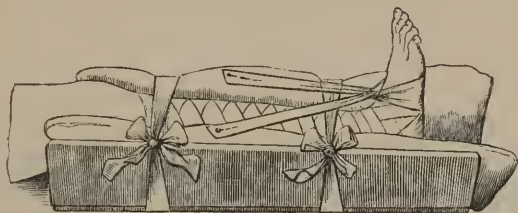


A proper degree of extension and counter-extension being now made, the bandage should be neatly applied and fastened by a pin. The splints should then be taken of such a length as to reach from the knee to a few inches below the foot, and rolled in the splint cloth so as to make firm pressure on each side against the pillow, and through that against the limb, after which the three strips of bandage should be firmly tied to hold it in that position, Fig. 293. The dressing is now completed by tying another strip of bandage in a loop about the instep, and fastening it so as to prevent inversion or eversion of the foot, and by placing a cradle properly made for the purpose, or two hoops tied crosswise over the limb, to prevent the pressure of the bedclothes. This dressing is preferable to the ordinary fracture-box, because, when the patient slips down in bed, the apparatus which is attached to his leg slips before him, and the upper fragment does not ride past the lower, as was shown to occur sometimes in the case of the fracture-box, the latter being objectionable except in hospitals, in the army and navy, or under circumstances where the patient can be completely controlled.

It occasionally happens that the force which produces the fracture drives the fragments into each other, or into the soft parts, so as to wound and irritate the muscles, produce spasm, and not only create shortening, but reproduce it after it has been reduced. Under such circumstances an apparatus may be required by means of which a suitable degree of extension and counter-extension can be kept up, though this is not generally demanded in injuries of the leg. Such an apparatus is that suggested many years since by *Hutchinson, of Philadelphia.*

**Hutchinson's Splint.**—This consists of two splints long enough to extend from the knee six or eight inches below the sole of the foot, with a mortise-hole at the lower end of both splints, and four large gimlet-holes at each of their upper extremities; of a strip about twelve inches long, two wide, and one thick, fitted to the mortise, and so perforated as to receive a peg in order to prevent the splints from separating, and of the means of extension and counter-extension. Extension may be made with the adhesive strips as applied in fracture of the femur, or by means of Barton's handkerchief, page 166. Counter-extension may be made by an assistant holding two

pieces of tape, eighteen inches long, on each side of the knee, while the sur-
geon secures them by numerous circular turns of a roller, or by means of
four strips of adhesive plaster two inches wide, and long enough to pass
spirally around the limb and cross each other externally and internally just
below the joint, as advised by Gilbert, of Philadelphia. The limb being
now covered by Scultet's bandage, page 622, carry the tapes or adhesive
strips through the holes at the top of each splint, and tie them outside the
splint; then draw upon the limb and tie the extending band to the cross
strip, arranging the pegs so as to prevent the splints either from separating
from each other, or pressing too closely on the limb. The cut shows very
intelligibly the method of application, padding and junk-bags being un-
necessary.

Fig. 294.
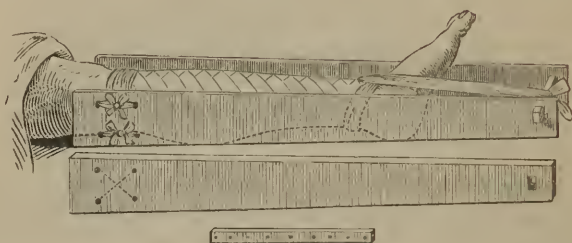


Should the leg swell very much, Physick's long splint for fracture of the
femur may be substituted, and the counter-extension made at the pelvis,
instead of below the knee. Hutchinson's apparatus is also not applicable
to fractures near the knee or ankle joints, on account of the irritation of the
extending and counter-extending bands.

After this dressing has been applied for five days, it will generally be
found that the spasm of the muscles has been overcome, so that there is no
longer any occasion to maintain so powerful a degree of extension and coun-
ter-extension as is secured by these splints; and if the patient begins to
suffer from the pressure of the extending and counter-extending bands, the
apparatus may now be laid aside. But there is a much graver reason for
laying it aside, and that is that the constriction of the limb necessary to
secure the counter-extending tapes interferes with the circulation. The
fragments are, therefore, not as freely supplied with blood as in the other
dressings, and this diminution in the quantity of the supply of nutritive
material may become so serious as to interfere with the formation of callus,
and cause the case to result in non-union, and in the production of that state
of affairs which will be described under the head of Pseudarthrosis. So
soon, therefore, as the spasm of the muscles is thoroughly overcome, the
splints of Hutchinson should be removed, and the limb dressed by the frac-
ture-box, or by the more secure and elegant dressings of Salter, or by that
of Boyer.

The treatment of a fracture of the leg by any of the means above detailed
requires that the patient should be confined to bed during a period varying
from six to eight weeks, or even longer; and that he should not be per-
mitted to rise at first without having his limb well bandaged and strength-
ened by pasteboard or similar splints moulded on the limb, these being worn
until the ninth week, to guard against rupture of the tender callus. Cir-
cumstances will, however, occur, which will render it extremely desirable that

he should be able to sit up and attend to his business during the treatment, or, as in the case of a soldier, it may become necessary for him to be removed to a considerable distance a few days after the accident.    Under such circumstances, resort may be had to some Immovable Apparatus, such as the Starch Bandage.

This bandage, though an excellent dressing, should not, however, be resorted to, in the treatment of even simple fractures of the leg, until all active inflammation has subsided; that is to say, not until the third or fourth day of the treatment at the very earliest, and seldom before the tenth.    In its application, a washed roller should be placed upon the limb, so as to cover in the foot and leg, and extend as high as the knee, *leaving the heel and toes exposed*, so as to enable the surgeon to judge of the state of the circulation in the limb.    If this precaution be not observed, serious injury may ensue.    The roller thus applied is then to be well smeared on its outer side with ordinary starch, or dextrine, if it can be obtained, and a second washed roller applied over the first in the same manner.    This roller having also been well coated with starch, two splints of binders' boards, cut to suit the size of the limb, are to be applied, one to the inside and the other to the outside of the leg, they having been previously rendered flexible by being well soaked in boiling water.    These splints should be cut so as to cover the sides of the foot, as in Fig. 295, but yet leave the heel and toes exposed. A third roller being then carried round the limb, and well starched to keep the splints in position ; a fourth, applied over the whole, completes the dressing.    The limb should then be laid in an empty fracture-box, the foot made fast to the foot-board, and the whole kept at perfect rest until the starch becomes firm, which it does in the course of two or three days, dextrine hardening more readily than starch.    Should the patient complain of the above apparatus after it has hardened, or should the condition of the skin of the toes and heel present evidence that the bandage has been too tightly applied, or that it has shrunk, it should be slit down in front with a pair of scissors to relieve the constriction, and another starched bandage applied over the whole, to secure it at the proper point and prevent it from becoming too loose.    On the other hand, should shrinking of the muscles or a diminution of the swelling leave the bandage too loose, as will not unfrequently be the case, another well starched bandage may be applied over the whole to make the requisite degree of compression.

To patients possessed of sufficient intelligence and prudence to understand the necessity of caution in moving about, the immovable apparatus will often prove a great comfort, and I should not object to their sitting up with the limb supported, as soon as the apparatus had thoroughly hardened.    In the case of a lawyer, with a fracture of both bones of the leg, to whom I once applied it at the commencement of the third week after the injury, it afforded great relief, and enabled him to sit at a table and write, as well as attend to his office business.    Its success will, however, depend on the proper application of the bandages and the selection of a case free from inflammatory swelling ; without this caution the effects will, doubtless, prove unfortunate.

Another immovable apparatus which, with the same precautions as the above, may be used in similar cases, is the apparatus of *Laugier*.    Having applied the French spiral of the lower extremities as described in connection with the starched bandage, coat it well with common glue ; and cutting a number of strips of coarse brown paper of the proper length, apply them regularly up the limb, like the bandage of Scultet.    This being done, coat them also with glue, and apply another set in the same manner ; repeating this operation four times, till the limb is securely supported by a coating of

intermingled paper and glue, which when dry will make a solid splint, and answer the same indications as the starch bandage.

Another that I have found useful is a mixture of plaster of Paris and gum-arabic, in the proportion of one part of powdered gum-arabic to twelve of the dry plaster of Paris, by bulk, keeping up extension while it is drying. Gum-arabic and whiting has been recommended also by Smee, of England, and white of eggs and flour by Larrey, these being laid over the bandage with a brush before either of the compounds harden, and act on the same principle as the starch and dextrine of Sueting.

**Pirogoff's Treatment of Fractured Limbs by the Plaster of Paris Bandage.**—Weber, of New York, reports* two cases thus treated.

"The following articles for bandages are wanted: Long, old hospital stockings opened at the seam; old drawers, jackets, or waistcoats of linen, for fractures of the thigh; belts which can go round the pelvis one and a half times; old linen, cotton, and cushions filled with lint or flax, (to fill up depressions round the ankles, etc.; splints of different lengths, cut of two or three layers of the coarsest linen, and strips of the same material.

"The splints must be two to eight fingers broad, and a little longer than the injured limb; the strips ought to be two to ten inches broad, and reach two to three times round the limb.

"At last a quantity of plaster of Paris, perfectly dry and finely pulverized, and cold water, with brushes, are to be kept in readiness.

"It takes some practice to make the solution not too thin nor too thick, so that it dries neither too slowly nor too fast.   Equal parts of water and plaster will be the best proportion.   When the application of the bandage takes up more than ten minutes, a few drops of carpenter's glue will retard the process of hardening for a quarter of an hour, and longer.   On the application of the plaster of Paris bandage the injured limb is first covered with dry linen; the depressions and projections are filled with cotton; extension and counter-extension is made *lege artis;* and then the splints soaked in the solution are applied lengthwise close to the limb, and fastened across by the strips.   Instead of the strips a roller may be used, which has to be covered with the solution by means of a brush, gradually throughout the time that it is applied.

"At the exterior margin of the limb the splints are applied, so that a small space of an eighth of an inch in width is left open.  A piece of tape soaked in oil marks this space.   The strips are also oiled crosswise in their middle, so that the solution is not taken up there; the oiled parts must fit the line of the tape; in this way a small space is left open, and uncovered by the plaster of Paris, so that the bandage can either be made tighter by the application of a new roller, or easily cut open to be removed.

"The plaster of Paris bandage is well adapted to the quick construction of capsules, for the transportation of the injured."†

Various other dressings have been suggested to enable the patient to leave his bed by the second or third week of his confinement.   One is the splint known as the perforated splint, which is made of tin or flexible metal, perforated so as to render it light.   This having been moulded to fit the limb, Fig. 295, B, is fastened in place by means of straps and buckles, according to the old plan of Benjamin Bell.   Two of these splints are required, one—

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* New York Jour. of Med., vol. xvi. N. S. p. 341, 1856.

† Weber, from a German translation in the "Deutsche Klinik," 1854, from N. Pirogoff's monograph, which was written in Russian.   Weber prefers the application of a *flannel* roller next the skin, but follows Pirogoff in the rest of the dressing.

A, Fig. 295—having a continuation along the side of the foot to keep the ankle-joint at rest, and both having orifices corresponding in position with the malleoli.    Before putting them on, the bandage of Scultet should be

A        Fig. 295.        B
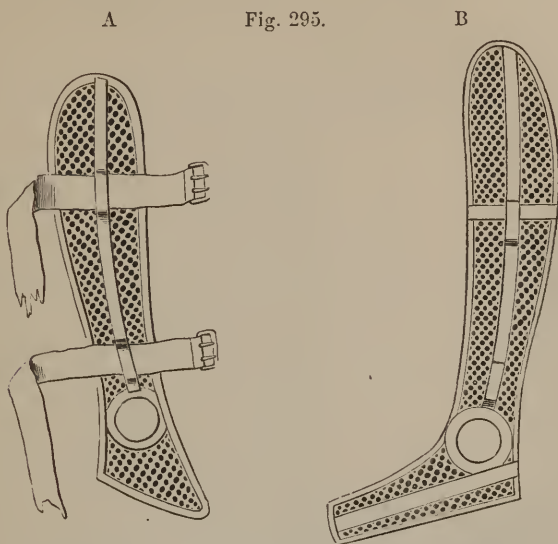


VIEW OF THE PERFORATED TIN SPLINT.—A. The inner splint, being a little shorter in the foot, the two fastening together by means of straps.   B is the splint for the outside of the left leg. (After Nature.)

applied, and wadding interposed at points between the splint and the limb, if it chafes anywhere.

Mayor, of Lausanne, Bonnet, of Lyons, Bauer, of New York, N. R. Smith, of Baltimore, Nott, of Mobile, Hamilton, of New York, and others, also recommend the application of wire splints under varied modifications; but it is

Fig. 296.
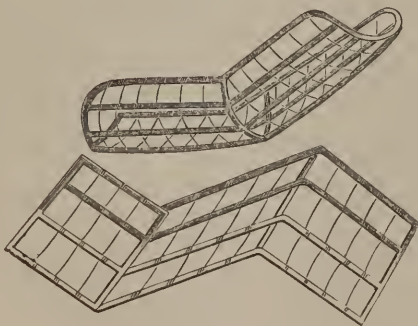


not always easy to obtain them, and they possess no special advantages over plainer wood splints, that are readily obtained.

Another apparatus for fractures of the leg consists of two similarly shaped wooden splints, figured in Bell's Surgery about the year 1800, one carved to fit the shape of the foot, and the other extending merely from the knee to

the malleolus, which answers the same purpose as the perforated splint, though not so well adapted to warm weather. It should, however, be borne in mind that neither of these splints can be safely applied in the earlier stages of fracture attended by tumefaction and inflammation of the soft tissues, but rather at a later period, when a certain amount of consolidation has already taken place, or when the first inflammatory action has been overcome and callus begun to form.

An excellent splint, although one adapted, like the perforated and carved splint, rather for the later than for the early stages of the treatment, has, for twenty odd years, been made of the ordinary Felt from the hatmakers, by cutlers in Philadelphia. A sheet of this article may be cut into a shape approximating that of the limb, and having been soaked in boiling water till rendered perfectly flexible, and cooled sufficiently to avoid vesicating the cuticle, applied to the limb, carefully moulded to suit all inequalities, and held in position by means of a roller. After having been allowed to harden, it may be taken off, coated three or four times with copal varnish, which will give it a firmness almost equal to that of the carved wooden splint, and then being carefully padded with cotton wadding, may be reapplied. Thin strips of wood coated with muslin, kid, etc., so as to be flexible, have also been long known, on the recommendation of Benjamin Bell; in fact, there is no limit to the variety of material thus employed, and especially applied to the leg.

Fig. 297.



### § 1.—Fracture of the Fibula.

The Fibula, like the tibia, may be broken at any point of its length.

The symptoms of this fracture in the upper part of the bone are so readily recognizable, and the treatment is so similar to that laid down in connection with fracture of both bones, that further reference may be omitted. But a fracture of this bone which deserves attention from the fact that it demands a special treatment, and presents a train of symptoms of a peculiar character, is that seated in the *lower fifth* of the bone, or within two inches of the external malleolus.

**Functions of the Malleoli.**—The chief resistance to a lateral dislocation of the ankle-joint during flexion and extension of the foot is the two malleoli, and the external and internal lateral ligaments of the ankle which are attached to them. It will, therefore, be perceived that if, from any cause, there is a solution of continuity in the fibres of the fibula, the functions of the external malleolus will be destroyed, and nothing can prevent a violent eversion, or even dislocation outward of the foot, and the production of such a strain upon the internal lateral ligament as may rupture it entire, or break at least a part of it. Or the force thus brought to play through the ligaments upon the bone, may rupture the fibres of the latter, and split off the internal malleolus from the tibia, so that both malleoli may be simultaneously fractured, a condition of which there are numerous specimens.

It will be easily conceived that the inflammation accompanying such an injury, attended as it very frequently is by laceration of the capsular ligament and of the synovial membrane lining the joint, may result in effusion into the articular cavity, and create more or less perfect anchylosis, thus interfering with the patient's motions, and producing a well-marked and inconvenient deformity.

**Etiology.**—The causes exciting this injury are often apparently slight; as when a patient walking hastily, treads upon a stone, or upon uneven ground, and turns his foot, or falls from a moderate height upon an irregular surface, turning the foot and bringing such a force to bear upon the external malleolus as produces the fracture.

**Symptoms.**—When the fracture occurs, great pain is experienced in the articulation, particularly when the foot is flexed or extended, but crepitation cannot readily be perceived in the majority of cases, because the firm character of the ligaments which bind the fibula to the tibia prevents that ready play of the fragments upon each other which would be likely to produce it. That a fracture exists, however, may, in the majority of instances, be ascertained by a simple manipulation; thus, pass the fingers carefully along the line of the fibula on the outside of the limb—in most patients it can readily be traced—and when the seat of fracture is reached, not only will the patient complain of pain, but the bone may be felt to give way under the finger.

**Diagnosis.**—The diagnosis, however, is sometimes a point of considerable difficulty, and requires patience and attention in order to prevent mistakes. A surgeon, for example, may be called to attend a patient who has stepped suddenly off a curbstone, and struck the sole of the foot upon some inequality in the ground, as a pebble or some similar substance, and find him unable to walk, and complaining of a great deal of pain in the joint, which is increased by flexion and extension of the foot. The ankle being also much swollen, especially laterally and anteriorly, the injury may readily be mistaken for a sprain or for a rupture of some of the fibres of the internal or external lateral ligaments; but knowing the probability, under the circumstances, of a fracture of the lower fifth of the fibula, he at once proceeds to a more minute examination with special reference to this injury, and finds that the function of the external malleolus is destroyed, that the foot can readily be made to fall preternaturally outward, and then, passing his fingers carefully along the line of the fibula as above directed, feels the bones give way, and recognizes the existence of the fracture.

There is, however, in some cases considerable and characteristic deformity; the upper end of the lower fragment being thrown against the tibia, leaving, as a general rule, the lower end of the upper fragment very nearly in position. If this deformity is not produced by the force which caused the fracture, it will often occur a short time afterward as the result of the contraction of the peronei muscles, whose tendons pass immediately behind the external malleolus. As a consequence of these changes, the foot falls outward, or may even be partially dislocated laterally, producing changes in the appearance of the limb which are quite characteristic.

**Prognosis.**—The prognosis will generally be favorable if the surgeon recognizes the injury and treats it properly.

**Treatment.**—In the treatment the first step is to guard against inflammatory action. The limb should therefore be laid on a pillow in a fracture-box and leeches freely applied; cloths wrung out of warm water, or the *cold* water-dressing if preferred, lead-water, and other antiphlogistic measures being resorted to; and it is not until the third or fourth day, when inflammatory action has much abated, that the surgeon should proceed to set the

fracture.   This may be done simply by coaptation, and turning the toes in-
ward, more so, indeed, than in their normal position, they being then held
by means of a roller attached to the end of the box.

After four or four and a half weeks the limb may then be taken out of the
box, and some supporting splint applied, as the carved splint, the perforated,
or the felt splint, Fig. 297, the patient being allowed to sit up or to walk
about his room with a crutch.   In about five weeks passive motion should
be commenced by the surgeon, to guard against anchylosis, and the limb be
gradually brought into use.   It will often, however, be seven weeks before a
patient can walk upon it without the use of a cane.   There is, moreover, a
class of fractures of the fibula at this point which are not so simple as those
above laid down; in which, owing to the fact that greater force has been
employed in the creation of the injury, the deviation of the foot outward is
more marked, and in which, therefore, a more decided force is necessary to
draw the foot inward to its proper line and keep it in position.   It is in
such cases that the dressing known as **Dupuytren's Splint** for fractures of
the lower part of the fibula is particularly applicable.   This apparatus con-
sists of a long wedge-shaped pad, Fig. 298, long enough to go from the knee
to the internal malleolus, and of a splint long enough to go from the knee
to some three or four inches below the foot.   The pad being applied with
its thick end downward on the inner side of the limb, the splint is to be laid
upon the pad, so that, by means of this apparatus, and of the turns of a
roller, the foot may be drawn much more powerfully inward than with the
fracture-box, as above described; the thick end of the pad acting as a ful-
crum, while the roller around the foot supplies the power.

Fig. 298.
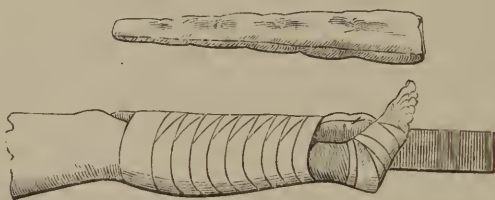


A side view of Dupuytren's Pad and Splint for the treatment of fracture of the lower fifth of the fibula as
applied to the right limb. (After Nature.)

In applying this roller, the rule is precisely the reverse of that ordinarily
obeyed in applying a roller to the lower extremities.   Instead of beginning
below and going upward, this roller begins above and comes downward.
The initial extremity of it is therefore to be laid upon the limb just below
the knee, and two or three circular turns made to fix it; then, with spiral
turns—reverses being seldom desirable or necessary—the bandage should be
made to descend toward the foot with moderately firm turns.   When the
seat of fracture is reached, it should be left uncovered, so as not to cause
the fragments to encroach upon the interosseous space, and thus counter-
act the very purpose for which the apparatus was intended, and when the
foot is reached the turns of the bandage should be more firmly applied, in
order to draw it forcibly inward.   By means of this dressing, the tendency
of the peronei muscles to draw the foot outward is completely overcome.

Still, there are objections to this dressing of Dupuytren.   The firm press-
ure made upon the internal malleolus is not well borne, ulceration and
sloughing may result if it be too long persevered in, and the patient, more-

over, generally complains so much of it that it is often necessary to take it off, rub the parts with liniment and reapply it, or abandon it altogether within twenty-four hours after its first application. Fortunately, however, even twenty-four hours' use of the apparatus is generally sufficient to overcome the tendency to eversion of the foot for which it was required, and the dressing, with the fracture-box given above, will generally be sufficient for the treatment of the case from the commencement.

## SECTION IV.

### FRACTURES OF THE TARSUS.

The bones of the Tarsus are sometimes the seat of fracture, and any of them may be broken. Generally, however, the force producing the injury is so great as to create extensive laceration of the soft parts, and the fracture is therefore usually a compound one. Still, simple fractures of the bones of the tarsus sometimes occur : thus the **Astragalus** is occasionally broken by falls upon the foot, the force being transmitted from the os calcis to it, and meeting with the resistance offered by the articulating surface of the tibia, it gives way, thus increasing the apparent width of the joint, and lacerating the articular cartilage and the synovial membrane. The results of such an injury are apt to be synovitis, effusion of lymph, and partial or complete anchylosis.

The injury can generally be recognized by the tendency to displacement when the foot is flexed or extended, and but little can be done toward repairing the mischief by setting the fragments. The treatment will, therefore, rather consist in the employment of leeches and antiphlogistic measures to combat the inflammation, than in the means calculated to keep the fragments in position.

**Fracture of the Os Calcis.**—The os calcis is occasionally the seat of fracture, generally the result of falls in which the feet of the patient strike the ground. The most frequent point at which the fracture occurs is through the posterior third of the bone, at some point intermediate between the articulation with the astragalus and the insertion of the tendo-Achillis. When such a fracture takes place, the deformity which ensues is marked and easily recognizable, the contraction of the gastrocnemius and soleus muscles acting through the tendo-Achillis inserted into the fragment, causing it to be drawn up to a position posterior to the articulation of the tibia with the astragalus.

**Symptoms.**—The symptoms will be pain, swelling, and all the ordinary symptoms of fracture elsewhere ; besides which there will be loss of motion in the foot, destruction of the natural prominence of the tendo-Achillis, and the deformity consequent upon the elevation of the fragment which has been described.

**Treatment.**—In the treatment it will be necessary to extend the foot upon the leg as much as possible, and to apply force in such a manner as to overcome the resistance of the gastrocnemius and soleus muscles, so as to bring the fragment down into position. The dressings by which these indications can be carried out are varied ; perhaps the best, however, is that suggested by Dessault. A wad of lint, charpie, or raw cotton being laid over the toes to protect them from the pressure, a strip of broad bandage or of muslin is carried from the instep down over the toes, up along the sole of the foot and back of the leg, and retained in position by an assistant. The upper fragment of the bone being then drawn down and held in position as well

as possible, two or three circular turns should be made around the ankle with a view of fixing the bandage, which is then to be carried over the front of the instep to the toes, and made to ascend the foot by the ordinary spiral turns. When the heel is reached, a number of figure of 8 turns should be made to retain the fragment in position, and as soon as it is sufficiently secure the

Fig. 299.



A side view of Dessault's Dressing for Fracture of the Os Calcis, the splint on the top of the foot and leg keeping the foot extended, and thus approximating the body of the os calcis to the fragment which is drawn up by the action of the muscles of the calf. (After Nature.)

roller may ascend the leg as in the ordinary spiral reversed bandage of the lower extremity.   This latter part of the bandage not only serves to fix more securely the muslin strip which was carried down over the toes, but by compressing the muscles on the back of the leg diminishes the probability of their contracting in such a manner as to reproduce the displacement of the upper fragment.   The dressing is completed by placing a straight splint well padded along the front of the limb, and retaining it in place by means of a roller so as to keep the foot firmly in the extended position in which it was placed, Fig. 299.

It will be observed that the principles carried out in the treatment above described are precisely the same as those laid down in connection with frac-

Fig. 300.



tures of the olecranon process of the ulna and fractures of the patella.   In both these cases, as well as in fracture of the calcis, the figure of 8 turns, or some modification of them, are required to draw the fragments down into

position ; in all, compression is required to counteract the action of those muscles whose contraction would produce separation of the fragments and reproduction of the deformity, and in all the use of a splint or some substitute is necessary to give greater firmness to the dressings.

After this dressing has remained upon the limb for two or three days, it should be removed, and the fragments carefully held in position while the limb is rubbed with soap liniment to obviate any evil effects from compression or from obstruction of the capillaries, after which the whole dressing may be reapplied as before. After six weeks this apparatus may be laid aside, and a simple and lighter dressing substituted, which may consist in a slipper such as that used for a side-saddle, or an ordinary slipper cut down so as to resemble it, Fig. 300, which, being put upon the toes, and a piece of bandage fastened to it and brought up over the heel, the band should be attached to a laced gaiter made fast around the calf, so as to keep the foot in position. In a week or two more, passive motion may be practiced, and the limb cautiously and gradually brought into use.

Fractures of the other bones of the **Tarsus** or of the **Metatarsus** and **Phalanges** sometimes occur; and are generally due to some great violence of a crushing character, as the passage of a wagon wheel or railroad car. In consequence of the character of the causes these fractures are, therefore, most generally of the compound class : tendons being torn and lacerated, ligaments ruptured, inflammation set up, and the patient fortunate should union occur with anchylosis. Besides which it should not be overlooked that the injury thus done to these bones often results in necrosis or caries, which gives trouble for many months, and not unfrequently necessitates amputation. All that can be done, therefore, in such cases, is to coaptate the parts as accurately as possible, to put the limb in a fracture-box, and to combat inflammatory action by the use of the cold water-dressing.

There is one point, however, in connection with fractures of the phalanges of the foot which demands attention. It will be seen by reference to the subject of the treatment of fractures of the phalanges of the superior extremities, that it was recommended in that place to endeavor, when anchylosis between the phalanges seemed inevitable, to cause it to occur in a flexed position, so as to obtain the greatest amount of usefulness that circumstances would permit. Now the rule to be laid down with regard to the phalanges of the foot is precisely the reverse. Should anchylosis occur in this case in the flexed position, the prominent knuckle presented by the bent phalanx would soon, from the pressure of the boot or shoe when the patient began to walk about, become the seat of a painful corn; or ulceration would occur, and the toe become such a source of suffering and annoyance that more than one case has occurred in which the patient has submitted to amputation rather than endure it any longer. To avoid this, the rule laid down in the case of fractures of the phalanges of the foot is, to endeavor to induce anchylosis in the *extended position*, by which all such inconveniences are avoided.

**Fracture-bridges,** etc. are often spoken of, to keep the weight of the clothes off the foot, and special directions given for their construction, but nothing more is necessary than two halves of a common hoop tied together in the centre, as shown in the fracture of the thigh, by Physick's plan.

## SECTION V.

### COMPOUND FRACTURES.

A **Compound Fracture** is one in which there is a wound communicating with the ends of the fractured bones. This wound may be caused either by the force which originally produced the fracture, or by the sharp ends of the broken bone. The presence of the wound alone distinguishes it from simple fracture, and any bone which may be the point of simple, may, there-fore, become the seat of a compound one. Thus, a patient may fall from a height and break his thigh; while the same force which produced the fracture may drive the sharp ends of the fragments through the skin, so as to cause them to protrude externally; a compound fracture being thus created. In such a case, in addition to the ordinary dangers of the fracture, we must note those resulting from the wound of the soft parts, from the probable injury to great blood-vessels and nerves, and from the fact that the contact of atmospheric air with the fractured bone produces certain changes highly unfavorable to speedy union, requiring the same action as was seen in wounds of the soft parts, viz.: the formation of granulations, suppurations, etc. In fact, a compound fracture heals only by the "second intention," while a simple one heals by "union by adhesive inflammation." (See FORMATION OF CALLUS, p. 536.)



Fig. 301.

View of a Compound and Comminuted Fracture of the leg. (After Miller.)

**Treatment.**—To prevent the injurious effects of the contact of atmospheric air with the cavity of the wound, the parts should therefore be closed as speedily as possible. If the muscles have spasmodically contracted around the protruded fragments, the patient may be etherized, in order that the muscular relaxation thus induced may permit the fragments to be restored to their place. If this is not sufficient, the orifice through which the bone has protruded should then be cautiously enlarged by a bistoury; and if that fails to secure the desired object, the ends of the fragments may be sawed off, an operation from which the surgeon should not shrink, as nature will perform the same process, though more slowly, and with more danger to the patient, by exfoliation, if the parts are let alone.

Having reduced the fracture, and coaptated the fragments as well as possible, the entrance of the atmosphere may be prevented by means of the artificial scab of Sir Astley Cooper. This is simply a piece of lint well soaked in the albumen of an egg, and laid over the wound; it dries speedily, and effectually excludes the atmosphere.

An admirable dressing for compound fractures, especially of the leg, is the **Bran Dressing** of Rhea Barton, of Philadelphia. This excellent plan of treatment consists of a fracture-box with fixed sides, at the superior extremity of which a piece of bandage is fastened with tacks, to prevent the bran from escaping; a little bran being placed in the box so as to form a bed for the limb, which is laid upon it, and the fracture carefully coaptated, after which bran is poured into the box, so as to cover the limb completely. No other dressing is required. The discharges from the wound are absorbed by the bran, and can be removed from day to day, the soiled bran being replaced with fresh. This dressing is very comfortable and easily obtained, and at the same time serves to exclude the atmosphere. It will be found very useful in hospitals, and especially where there is a tendency toward the production of erysipelas.

The influence of the atmosphere in retarding the healing of wounds of the soft tissues alone, must also be noted in connection with the treatment of compound fracture; and often it will be found impossible to induce a closure of the wound and a restoration of the injury to the state of a simple fracture. During the efforts of nature to accomplish this, free suppuration, burrowing of pus under the fasciæ, sinuses, hectic fever, and sometimes tetanus, will materially complicate the case, and render the preservation of life a matter of difficulty. Tardy and deformed union also not unfrequently results, and hence many have advised the performance of amputation of the limb in most compound fractures. If done, should amputation be promptly performed, or delayed until the constitutional irritation is marked? In other words, is primary or secondary amputation preferable? Without entering into a discussion of this long-mooted point, it must suffice here to lay down the general principles applicable to most cases.

1. In military life, primary amputation is preferable.

2. In civil life, where good nurses and every convenience can be had, secondary amputation is, I think, most desirable, as will be again referred to under the subject of amputations.

But amputation for compound fractures should only be performed, in either position, when the fractured bone is not (like the femur) near to the trunk; when the soft tissues, especially the skin and areolar tissue, are lacerated and infiltrated with blood; when a large joint, as the shoulder, carpus, or knee, is freely opened and the bone splintered.

In the compound fractures caused by railroad accidents there is so often injury done to vital organs that is not apparent at the moment, and which subsequently causes prostration and death, that I usually counsel delay, not amputating in these cases for the first eight or ten days. If the patient survives this period and is etherized, the success of the operation has, in my experience, been better than in the cases operated on immediately after the reaction from the injury. Amputation in a compound fracture should always be the subject of a consultation of surgeons, if it is possible to obtain one; and I desire to impress on the young practitioner the possibility of there being, in railroad injuries, some other part affected than that which, like the broken limb, is so very evident to the by-standers. Should mortification supervene on a compound fracture, amputation should be promptly performed, as advised by Larrey, without waiting for the line of demarkation, as is the usual practice in spontaneous mortification. (See MORTIFICATION.)

Whether a compound fracture demands amputation or not, the necessity of supporting the patient's strength by good diet, etc. should be recollected.

## SECTION VI.

### DEFORMED FRACTURES.

From various circumstances, it not unfrequently happens that fractures unite in such a line as creates a marked deformity, and renders the limb more or less useless.

Treatment.—The treatment of such cases must of course vary as greatly as the variety in the cause and amount of the deformity. When the deformity is seen during the period when the callus is flexible, pressure, judiciously applied, so as not to interrupt the circulation of the limb, will often be sufficient, as by the application of pads and splints on the projecting side. If the case is of longer standing and the union more perfect, greater difficulties are presented. In these cases the callus must be broken through by force applied by the hands of the surgeon, so grasping the bone that he may snap it across his knee; or by binding one fragment to a splint, the padded extremity of which reaches only to the seat of fracture, and thus constitutes a lever to elevate or depress the fragment attached to it; or the callus may be weakened, as recommended* and practiced by Brainard, of Chicago, by perforating it in numerous places, subcutaneously, by means of a drill, and then applying, some eight or ten days subsequently, force sufficient to break the bone. When the union is so firm as to resist these plans of treatment, resection may be performed, as hereafter stated, vol. ii. Resection of a fracture is, however, apt to be followed by erysipelas and all the dangers of a compound fracture, these often inducing a typhoid condition of a most serious character. The operation should, therefore, be kept as a last resort, and only employed with the anticipation of a tedious after-treatment of months, and the risk of the patient's life.

# CHAPTER VII.

## PSEUDARTHROSIS, OR UNUNITED FRACTURE.

In studying the formation of callus, or the healing process after a fracture, it has been shown that the bond of union was the result of inflammatory action in the periosteum, endosteum, and Haversian canals, both the membranes influencing the cell action of their respective tissues so as to lead to the formation of osseous matter. When, from various causes, this healing process is interrupted, or when, instead of development there is an involution of structure, certain changes of the ends of the fractured bone and the surrounding tissues are induced, that leave a condition of the bone designated as **Ununited Fracture**; or, from the increased mobility and general appearance of the part, as **False Joint**, or **Pseudarthrosis**.

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* Transactions Am. Med. Assoc., vol. vii., 1854.

Ununited fracture results occasionally in the femur, humerus, tibia, radius, ulna, lower jaw, and clavicle, the relative frequency of each being usually in the above order. Hamilton, of New York, reports,* however, that he has found fracture of the humerus more frequently ununited than the femur, while my observation shows the femur ununited much more frequently than the humerus. Malgaigne has probably furnished the most correct statement, in asserting† "that no reliable statistics have yet indicated the degree of frequency of this annoying termination of fractures." The statistics furnished by Norris, of Philadelphia,‡ in a valuable paper on this subject, shows "that, of 946 fractures treated in the Pennsylvania Hospital, union failed in but one; while 13 cases, during the same period, entered the house treated elsewhere"—a valuable example of the advantage of the simple plan of treatment pursued in that institution.

**Etiology.**—The causes of ununited fracture may be classified as general and local. Among the general causes will be observed certain depraved conditions of the system, such as that found in scorbutus, purpura, certain low forms of fever, pregnancy, cancer, mollities ossium, secondary syphilis, etc., in which the blood is so vitiated as not to furnish to the cells of the periosteum and endosteum the proper amount of nourishment. The local causes are varied, being such as check or modify the local cell action of the periosteum. Thus, it may result from improper treatment on the part of the surgeon, who, by too frequent dressings, or by the use of such means as do not keep the fragments at rest, may cause or allow, especially during the first twenty days, such a degree of motion in the fragments as will break up the newly-formed vessels of the lymph, destroy the organizing granulations, and finally prevent the formation of callus; or, the pressure of a bandage or a splint may be made in such a manner as to interrupt the circulation of the limb, and cut off the supply of blood from the fragments. Another cause may be the introduction of a fibre of muscle or tendon between the ends of the bone, these acting, in such situations, as foreign matter; or false joint may result from the manner in which the extremities of the fragments present toward each other; as when an external periosteal surface is presented to the cancellated tissue and open Haversian canals; or two external periosteal surfaces may be presented to each other, it being, it must be remembered, only the inner layer of the periosteum that furnishes new bony tissue. It will thus be readily understood, that the condition called false joint is simply that state of a fracture in which, from want of action or from over-action, the lymph formed for the repair of the injury is not sufficiently organized to result in osseous union.

**Condition of the Part.**—Three distinct conditions of the ends of the bones and the surrounding tissues have been noted in false joint, all being indicative of an arrest of the healing process in a fracture before it had resulted in the perfect formation of callus. Thus:—

1st. The ensheathing callus continues soft and flexible, the organization having been checked, or the reparative action, especially of the external periosteum, having been arrested.

2d. The ends of the fragments, with the surrounding soft tissues, being atrophied, the fragments dangle on each other through fibro-ligamentous tissue without the support of muscular action, there being no ensheathing callus, Fig. 302, 2.

3d. The reparative process in the intermediate callus has progressed so

far as to close the medullary canal, the ends of the fragments being rounded and solid, as in bones after amputations, the action of the periosteum resulting only in fibro-ligamentous tissue on their circumference, Fig. 302, 3.

Fig. 302.
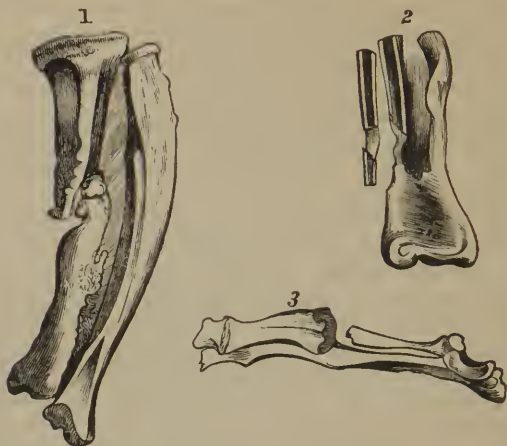


A VIEW OF THE DIFFERENT CONDITIONS OF THE BONE IN UNUNITED FRACTURE.—1. Ununited fracture of the tibia, with increased thickness of the fibula, the ends of the fractured bones being coated with a compact layer and surrounded by some irregular callus.  2. Ununited fracture of the ulna, showing the ligamentous union between the ends of the fracture.  3. Ununited fracture of the radius, showing the great enlargement of one fragment and the wasting of the other. (After Hines.)

To these Boyer added the appearance between the ends of the fragments, simulating the natural structure of a joint, as articular cartilage, synovial membrane, capsular ligament, Fig. 302, 1 ; but says, "he never found in their structure anything like articular cartilage," etc.  Rokitansky, on the contrary, admits the existence of articular cartilages and a synovial membrane; though, as the production of these parts, as the result of a fracture, is certainly a new and independent creation of tissue not previously existing in the part, there is some reason for hesitation in accepting it even on such authority.  That the ends of the fragments may be rounded, polished, and held together by a surrounding fibro-ligamentous tissue, is undoubted; but the presence of an articular cartilage or synovial membrane is not, to my mind, satisfactorily proved. In the tardy union of fractures we have the first condition above enumerated; in false joint of the smaller bones, as the radius, ulna, and fibula, we usually find the second ; and the third represents the state of parts in a chronic ununited fracture of the humerus, femur, and tibia.  When an ununited fracture is near an articulation, it sometimes assumes a ball-and-socket form, one end furnishing ensheathing callus.

**Symptoms.**—The symptoms of ununited fracture are, increased mobility in the limb, motion existing at an unnatural point, inability to perform the function of the bone affected, with pain on motion if one fragment, as in the clavicle, can be made to press on adjacent nerves.

**Diagnosis.**—The presence of motion in an unusual point, the wasting of the limb, and the sense of touch render the diagnosis usually easy.

**Prognosis.**—The prognosis should be guarded, depending greatly on the duration of the affection and the bone involved.  Ununited fracture does not absolutely destroy the use of the arm or forearm when seated in these bones, but when located in the thigh and leg the patient is usually unable to stand or move about without crutches.  The age and health of the patient, and the

means of treatment selected, will also modify the prognosis; of the latter, as hereafter mentioned, resection is specially dangerous to life. All are liable to failure, but none can ever demand amputation of the limb. By the use of the splint and the principles of *pressure and motion*, hereafter detailed, the prognosis is made more favorable, because if no cure is obtained the limb will at least be more useful than it would be if amputated, while in some instances the member has been almost as useful as it was before the injury.

**Treatment.**—The formation of callus being due, under ordinary circumstances, to increased vascular action in the part, the means of treatment generally suggested for the cure of false joint have assumed the necessity of stimulus as a fundamental point. With the view of hastening nature in the formation of the much-desired bond of union, and in some instances without much reference to the difference in the state of the bones in a recent fracture, and in one which has existed many weeks, surgeons have urged the employment of local stimulants to all cases, without specifying the conditions which demanded it. Of course, means which were useful in one period of a fracture could not be equally so in another; yet but little distinction has, in many cases, been made between the treatment of a false joint of three, or of eighteen months' standing. Thus, friction might be useful in the first, but of no service in the last; while resection might be attempted in an old case, and yet not be justifiable in a recent one. The following plans of treatment, which have been suggested from time to time, sufficiently illustrate the views of surgeons in the pathological condition of false joint, as well as the ingenuity of each surgical period, and its dissatisfaction with the means of treatment previously recommended.

Of these plans for obtaining union, the earliest recorded is to be found in the writings of Celsus, and consisted in the employment of such manipulation as would cause *friction* between the fragments, break up any ligamentous bands that connected them, and create a degree of local disturbance similar to that seen in a recent fracture. Various modifications of this plan have been employed by surgeons down to the present time, and considerable diversity of opinion as to its efficiency has existed. It is especially useful in cases of tardy union after a fracture rather than to a true false joint.

Next in antiquity is the plan described by Avicenna, which consisted in exposing the seat of fracture and *scraping or rasping the extremities of the fragments*. This plan was specially applicable to old ununited fractures, in the fragments of which the medullary canal was closed. It has been resorted to in more modern times by John Hunter, Barthelemy and others, and was employed in 1834 by Sir Benjamin Brodie. To this succeeded *resection of the extremities of the fragments*, which was brought into notice by White, of Manchester, in 1760; previously to this however, Petit had removed, with a trephine, the extremities of the fragments in a case of pseudarthrosis, and the operation is said to have been known in the time of Avicenna. Both extremities were removed by White in his original operation, but subsequently he, Inglis, and at a more recent period Dupuytren, succeeded in cases in which but one of the fragments was resected. Another modification of this operation was that of Roux, who, after excision of the extremities of the fragments, engaged the point of one in the medullary canal of the other.

Yet another modification consisted in fastening together the resected extremities with silver or other wires. This has been done in the case of the lower jaw by wiring the *teeth* together, as practiced, after resection of the fragments, by Horeau in 1805, Dupuytren in 1818, and by Kearney Rogers, of New York, who, in ununited fractures of the long bones, retained the

fragments in position by wires passed through holes drilled in the extremities of the fragments after their resection.

White, of Manchester, also practiced *the application of caustic to the fractured extremities*, successfully employed the butter of antimony for this purpose, in a case in which he had a week previously resected the fragments. Cline, of London, subsequently applied caustic successfully without resection. And the same was done by Earle, of England, in 1821, by Hewson, of the United States, in 1827, by J. R. Barton and Norris, of Philadelphia, in the Pennsylvania Hospital. Caustic potash was used by most of these gentlemen, but other caustics have been applied for the same purpose, such as fuming nitric acid, which was successfully made use of by Ollenroth. *The actual cautery* had, however, been applied to the fragments at an earlier period by Petit, in the case in which he had removed with a trephine the carious extremities of the bone.

*The seton* is said to have been originally proposed in the treatment of these cases, by Winslow, but was first brought into general notice by Physick, of Philadelphia, who employed it successfully as early as 1802. The seton was passed in between the fragments, especially in the humerus, and retained until union was complete, but did not answer when applied to the femur by Physick. The seton was also employed by Percy, of France, and others.

In 1828 Sommé, of Antwerp, modified this operation by the employment of wire instead of the silk suture of Physick; his case was successful. Another modified employment of the seton consisted in passing it near the fragments, especially in cases in which from any cause it was difficult, if not impossible, to pass it between them. This practice has been successfully resorted to by Oppenheim, who passed two setons *near* the seat of fracture, in 1828; by Saawer, in 1833; and has also been recommended by Gulliver and Rhynd, of Dublin.

**The application of caustic potassa to the skin** over the seat of the fracture was successfully employed by Jos. Hartshorne, of Philadelphia, in 1805, and subsequently in 1811 and 1838.

**Compression**, by means of a tin plate over the fracture, and a bandage, was successfully used in 1805 by Inglis, the patient being permitted to move about as well as he could after the application of the dressing. A somewhat similar plan is said to have been employed several years previously by White, of Manchester. Pressure combined with rest was first recommended by Amesbury, but necessitates confinement to bed when the false joint is in the bones of the lower extremity.

**Blisters over the seat of the fracture** were proposed by Walker, of Oxford, in 1815, and have since been recommended by Sir B. Brodie and Velpeau.

**Iodine** in the form of tincture, applied with a small brush to the skin, over the seat of the fracture, was suggested by Buchanan, of Hull, and has since been made use of with good results by Crosse, Trussen, Willoughby, and others. These means are especially adapted to cases of tardy union, and not to a chronic case of false joint.

**Heat** was employed with success by Mayor, in 1828, by passing a large canula between the fragments, and introducing into this a rounded iron heated by holding it in boiling water. **Electricity** has also been resorted to with good results by Birch, of London.

The use of **mercurials** carried to salivation was suggested by Sir Stephen Hammick, in 1830, but is at present but little esteemed.

**Stimulating injections**, as port wine and water, salt and water, and solution of sulphate of copper, were successfully employed by Hulse, of the

U. S. navy, in a case accompanied by a fistulous opening, and reported in 1834.*

Acupuncture was unsuccessfully attempted by Malgaigne, in 1837.

Seerig treated a case successfully† by passing a ligature around the ligamentous tissue connecting the fragments, and tightening it daily by means of a screw.

From the above summary, condensed mainly from Norris's valuable paper, it is evident that surgeons have been dissatisfied with the result of each plan presented.

Of a more recent date are the plans of Dieffenbach to excite action by exposing the fragments, drilling holes in them and then inserting ivory pegs.

Brainard, of Chicago, advised a treatment by drilling the fragments subcutaneously; while the author, in 1855, invited attention to a modification of the old plan of pressure and rest, so as to obtain Pressure and Motion in the fragments, the patient using the limb constantly throughout the entire treatment.

Fig. 303.



The plan of Dieffenbach has been in numerous instances followed by cure. That of Brainard, proposed in 1853, consisted in piercing the extremity of each fragment at several points, by means of an awl-shaped perforator (Fig. 303) passed once down to the bone and then partially withdrawn, so as to perforate the bone several times without the instrument being removed from its original puncture in the skin until the termination of the operation, the air being carefully excluded by this subcutaneous perforation, and the puncture of the soft parts promptly closed by collodion on the withdrawal of the instrument. The drilling is to be repeated every ten

PERFORATOR or DRILL, applicable to false joint, vicious or deformed callus, etc. (After Nature.)

days until union is obtained, the limb being all the time maintained at perfect rest by means of splints, etc.

Nineteen cases thus treated have been reported,‡ viz.:—

| | |
|---|---|
| Humerus | 4 |
| Femur | 5 |
| Radius | 1 |
| Ulna | 3 |
| Tibia | 5 |
| Infra-maxillary | 1 |
| | — |
| | 19 |

Of these, 1 left while under treatment, another failed, and 17 recovered with-

* Am. Journ. of Med. Sciences, vol. xiii.
† Archiv. Gen. for Jan. 1839.
‡ Chicago Med. Journ., March, 1860.

out serious accident; 2 had small abscesses at the point of perforation, and
1 (a case not cured) suffered from erysipelas, though this was milder than
that which follows resection.

In the hands of other surgeons the result of this plan, however, has not
been so favorable. Gross, of Philadelphia,* has tried it in several instances,
(using a trocar instead of the instrument of Brainard,) "but without obtain-
ing a single cure." Kinlock, of Charleston, also reports† a failure in an un-
united fracture of both bones of the forearm. Fenner, of Tennessee, likewise
reports‡ its failure in ununited fracture of the humerus; in this case the
seton also failed.

In all these varied plans of treatment, it is important to remember that
the patient has either been confined to bed for many weeks, at the risk of
losing his general health, or, after suffering from the performance of an
operation, been exposed to excessive suppuration, phlebitis, hectic fever, or
purulent absorption, especially when the bones were resected. These opera-
tions are, therefore, not only attended with great inconvenience, but often
with great danger, while frequently their failure has necessitated the amputa-
tion of the limb.

To overcome these objections in the treatment of false joint, I urged, in
1855,§ the advantages of **Pressure** and **Motion** as obtained by means of a
sort of artificial limb, and experience has since shown no case of failure
to obtain a useful limb even when union of the bones did not ensue.

That pressure and friction of the surface of the external periosteum leads
to the formation of bone, has long been known to surgeons, and exemplified
in the formation of a new acetabulum in cases of luxation of the head of the
femur upon the pubis, specimens of which are to be found in our cabinets.
Other instances from the head of the humerus are also well known, the result
not being a rare one. If, then, a rounded, smooth bone, like the head of a
femur or humerus, can, by pressure, lead to the absorption of muscles, and
then induce an osseous deposit around the free edge of the ulcerated or
absorbed periosteum, why should not the same results follow the application
of similar forces when the two periosteal surfaces are in apposition near the
seat of a fracture ? It most certainly does so, and leads to the development
of an amount of provisional or ensheathing, as well as of intermediate or
definitive callus, fully equal to the support of the body, of which I have
a marked example in the femur, Fig. 308.

How pressure and motion, acting on the external periosteum, lead to
the growth of new bone, or callus, is fully explained by the recent obser-
vations of histologists. From the remarks of Kölliker on the histology of
the osseous system,‖ it appears that in the growth of bone, the elementary
processes in the layers of the periosteum are as follows : The periosteum of
the primary cartilaginous bones being proportionally very thick and vas-
cular, consists, as early as the fifth month, of common connective tissue and
fine elastic ligament. On the inner aspect of this fully formed periosteum
there is deposited an ossific blastema (4) firmly adherent to the bone, (see
Fig. 304,) so that, when the periosteum is removed, it remains upon the
bone as a moderately thick, soft, whitish-yellow lamella, in which the micro-
scope shows fibrous tissue, and granular, oval, or round nucleated cells,
measuring $0.006.001$ of a line, from which, after a time, the bone cells are

* System of Surgery, vol. ii. p. 139.
† Am. Journ Med. Sciences, vol. xxxvii. N. S. p. 136, 1859.
‡ Am. Journ. Med. Sciences, vol. xxxix. N. S. p. 342, April, 1860.
§ Am. Journ. Med. Sciences, vol. xxix. N. S. p. 102, 1855.
‖ Manual of Microscopical Anatomy. Phil. edit. p. 324.

formed, out of the formative cells of the blastema, the soft bone lamellæ passing into the blastema. The development of the ossifying blastema, Kölliker regards as due to the numerous vessels of the young periosteum, the origination of its fibres being from fusiform cells, as he has frequently observed it in man and animals. The formation of bone in this blastema occurs, he thinks, wherever it is in connection with bone.

Without, however, enlarging on these physiological points, it may suffice to say that it is evident, from the action of the periosteum in old luxations, as well as in certain diseases and injuries of the bones, that this membrane is capable, under stimulus, of throwing out new bone, and that it is only necessary to excite it properly to lead to the formation of such an ensheathing structure as will restore the continuity of the bone in ununited fracture, and consequently the action of the muscles attached to it; thus reproducing the usefulness of the limb. Such means, I think, are to be found in the apparatus hereafter

Fig. 304.



TRANSVERSE SECTION FROM THE SURFACE OF THE SHAFT OF THE METATARSUS OF THE CALF, magnified forty-five diameters.—1, 1. Rudiments of the Haversian canals of the compact substance. 2, 2. Area of the canals. 3. External periosteum. 4. Ossifying blastema. 5. Young layer of bone. 6. More developed layer of bone. (After Kölliker.)

described, the formation of which was based on the following proposition: If a patient, after amputation of the leg or thigh, can sustain the weight of his body upon an artificial support, which is only a series of hollow cones, so adjusted as to play upon each other, at the joints, and thus facilitate progression, why may he not obtain the same support without amputation, from some similar mechanical contrivance, made sufficiently light to be moved by wasted and weakened muscles? Surely, but little mechanical ingenuity is necessary to the development of such means of progression; and in urging attention to those just described, I lay no claim to mechanical originality. It is the surgeon's duty to suggest the principles for the construction of an instrument or apparatus, and the business of the cutler, or other mechanic, to develop it in the material most capable of furnishing the qualities required of the apparatus. The suggestion of the principle of pressure and motion is the result of considerable observation of the defects of the treatment of false joint by the ordinary plans of treatment, of the diminished amount of callus seen in the union of fractures in which perfect rest has been maintained, of the extra amount of callus seen where there has been much motion of the fragments during the period of union, as well as of several dissections made by me of uncured cases.

To act properly, the pressure must be accurately applied, so as to keep the two periosteal surfaces in contact, while the use of the limb and the play of the fragments creates the friction. Hence, to be useful, the splints employed must be accurately adapted to the part, and the patient advised to exercise the limb as much as possible, *as this can be readily done from the moment the apparatus is well fitted either to the upper or lower extremity,* without there being any pain or other inconvenience. To the lower jaw and clavicle the same principle is equally applicable, though the form of apparatus would demand to be varied. In the clavicle I have succeeded in obtaining a cure while the patient used the arm daily, etc. In false joint of either of the upper or lower extremities, I am satisfied, from numerous observations, that this plan of treatment has much to recommend it, not the least of which is the fact that it enables the patient to use the limb during the entire period demanded for the union of the bone.

In every case the splints or artificial limbs should be made so as to fit accurately the part on which they are to be applied, each patient being carefully measured while a moderate degree of extension and counter-extension is kept up on the fragments, in order that any subsequent shortening of a marked character during the use of the apparatus may be guarded against.

When applied to an ununited fracture of the femur, the chief point of support in these limbs will be the conical-shaped piece which surrounds the thigh, this also making pressure at the seat of the false joint, the weight of the body being sustained by the belt that surrounds the pelvis, which, being united to the thin bars of steel that pass under the foot, as in the ordinary club-foot iron, partially supports the body at the hips independently of the femur, Fig. 307.
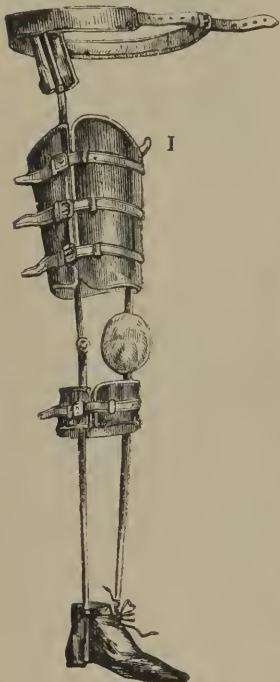
Fig. 305.                    Fig. 306.                    Fig. 307.
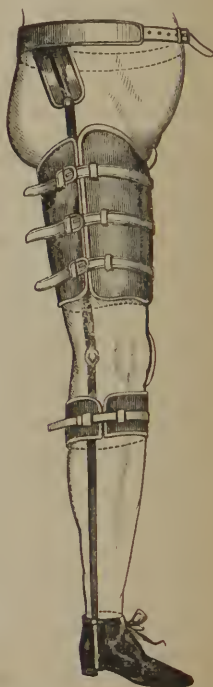


Fig. 305.—A view of Smith's Apparatus for the treatment of ununited fracture in the femur of the right leg—the inside piece terminating in a little padded head, I, which rests against the perineum. (After Nature.)

Fig. 306.—A side view of the Apparatus for the treatment of ununited fracture in the bones of the leg. (After Nature.)

Fig. 307.—A three-quarter view of the artificial limb as applied. (After Nature.)

In order to protect the knee, and prevent lateral deviation, the splint should be guarded by a padded plate on the inside of the joint, while a padded band surrounding the head of the tibia tends to distribute the weight of the patient upon the side bars, and strengthen the supports. The shoe should be made to lace all the way down the front, so as to facilitate the introduction of the foot.

When the ununited fracture is in the leg, there is no occasion for the pelvic band, the apparatus being made like Fig. 306, the support of the

body in this case being chiefly furnished at the head of the tibia, by the conical-shaped leg piece which buckles around the calf and the seat of fracture, the band around the middle of the thigh being merely intended to add to the steadiness of the limb in walking.

One patient walked with this apparatus as soon as it was applied, although there was no union at the seat of fracture, and several similar cases have been shown to the medical classes in attendance on the surgical clinics of the University of Pennsylvania. In measuring a patient for this or any other of these artificial limbs, moderate extension and counter-extension is necessary in order to prevent subsequent shortening. When the artificial limb is well fitted, subsequent shortening is prevented, the chief support being above the seat of fracture, and the resistance below it.

By the use of the artificial limb, above described, a patient laboring under false joint in the femur can walk about *immediately after its application,* if not as well as in a state of perfect health, yet at least better than he could do with an artificial leg after amputation.

Fig. 308.                                        Fig. 309.
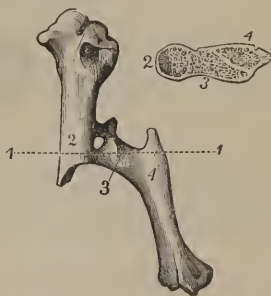


Fig. 308.—A front view of the mode of union accomplished in an old fracture of the femur. The callus formed between the fragments appears to be chiefly due to the action of the outer surface of the bone, or rather to the inner surface of the external periosteum after its outer layer has been absorbed.

Fig. 309.—A front view of the union obtained in a comminuted fracture of the humerus of a turkey, showing the fusion of compact with the cancellated structure of bone.—1, 1. Line of the saw in making a section. 2. Upper fragment of fracture. 3. Intermediate fragment. 4. Lower fragment. An end view of the section of the upper half of the bone is seen at the side of the drawing, and shows the perfect fusion of the cancellated structure of the intermediate fragment 3, with the compact structure of the fragments 2, 4. This union has evidently resulted from the absorption of the outer layer of the periosteum, without which it could not have taken place.

Soon after applying this apparatus to ununited fractures, it was shown that by the motion and friction in the bones, as developed by exercise, such inflammation was induced in the external periosteum as caused a large amount of ensheathing callus to be thrown out, Fig. 308, several obstinate

cases having thus eventuated in perfect cures.    Since this period, various others, embracing all the bones of the extremities, have been similarly bene-fited.    An additional advantage of this plan is to be found in the fact that if it fail in accomplishing union in any case, it is unattended by danger, and prevents the necessity of amputation, while a patient can use the limb dur-ing the treatment, and obtain plenty of fresh air and exercise, these adjuvants being most important in the treatment of such cases.

In the treatment of false joint in the humerus, surrounding the arm at the seat of the disorder, as well as the forearm—with a splint made on a similar principle, the two portions being united by means of a joint at the elbow—is all that is necessary in order to permit the use of the limb, even when there is no union, Fig. 310.

Fig. 310.
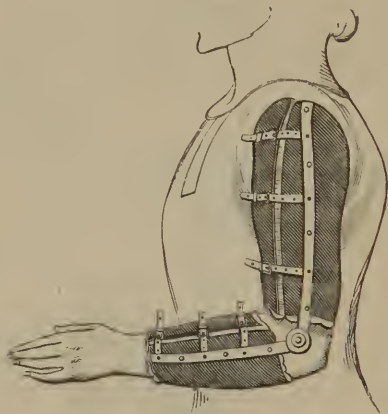


Fig. 310.—A side view of the artificial limb applied to false joint in the humerus.  In measuring the limb for this apparatus the humerus should be drawn as nearly as possible to its original length, and the artificial limb should rise well over the shoulder and fasten by straps to the opposite axilla if the false joint has fol-lowed a fracture of the surgical neck of the bone. As soon as this is well fitted, the patient can and should be encouraged to use the limb. (After Nature.)

In order to exhibit the results of cases already treated, I add the fol-lowing :—*

Case 1.—Under the care of Wm. Waters, of Fredericktown, Maryland. False joint in both bones of the leg, of eighteen months' standing, cured in five months, the patient walking about during this period.

Case 2.—False joint of both bones of the leg, of four months' standing, cured in nineteen weeks, also while walking, by Wm. Waters, of Maryland.

Case 3.—False joint in the femur, of five months' standing, cured in seven-teen weeks, while walking, under my own care.

Case 4.—False joint in the femur, of six months' standing, cured in nine weeks, also while walking, under my own care.

Case 5.—False joint in the femur, of twenty weeks' standing, cured in six weeks, under the care of R. J. Levis, of Philadelphia.

Case 6.—False joint in the left humerus, of six months' standing, treated by G. Dock, of Harrisburg.   Dr. Dock applied the principle of *pressure and motion* to this arm by an apparatus manufactured for the occasion, which was worn during three months, the patient "following, with comfort and ease,

* For a full account of these cases, see Am. Journ. Med. Sciences, vol. xxix. N. S. p. 117.   Also vol. xxi. N. S. 1851, p. 108.

during all this period, his occupation as a compositor in a printing-office."
At the expiration of this period the patient, without consulting his surgeon,
ceased to wear the apparatus, finding union firm.  Some days subsequently, in
making an effort, he broke it over again, and has not since been under treat-
ment.   This case showed very satisfactorily that it is possible, by a well-
applied apparatus, to enable a patient with ununited fracture of the humerus
to use the arm freely during the cure, or to use it perfectly well if union
fails.

Case 7.—False joint in the humerus, under the care of C. W. Ashby,
of Alexandria, was treated with the splint, and the "man expressed great
delight with it, as he could use the arm some, and with comfort."*  Circum-
stances removing the patient, the splint was removed by another surgeon,
and resection successfully performed.

In addition to these, I had previously noted a case of false joint in the
femur of a man upwards of seventy years of age, which failed to unite, but
which was made so firm by the apparatus that he walked only with the
assistance of a cane.   One case of false joint in the leg also failed, but though
the bones did not unite, the patient is yet able to walk.    I have also from
Mr. Rohrer, the cutler, reference to two other cases in the leg, cured by
surgeons at a distance, who have failed to respond to my communication
respecting them.

Geo. Dock, of Harrisburg, has also since reported a cure, in a bad un-
united fracture of the femur, by means of the artificial limb.

A. H. Halberstadt, of Pottsville, likewise treated an ununited fracture
of the femur with marked improvement, the patient walking well, with the
apparatus on, when last heard from, and experience, up to this date,† has
only tended to show the perfect success in numerous instances, in several
sections of the United States, of this plan of treatment, and the impropriety
of amputating limbs for a condition which can, under most circumstances,
be thus remedied sufficiently to give the patient the use of his limb even if
union does not ensue upon the application of the apparatus.

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* C. W. Ashby, in MS., 1860.                      † October, 1862.

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# PART VII.

## DISEASES OF THE BONES.

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## CHAPTER I.

### DISEASES OF THE BONES.

THE nutritive action that preserves the bones in a normal condition and aids their development during the period of growth, is liable from various causes to be so modified as to result in disease, these diseases or disordered actions corresponding in their general course and result with the disordered actions already studied in connection with the soft tissues. The diseases of the bones now to be examined will be presented under such heads as exhibit —1st. A modification of function, or of their normal nutritive action, as seen in hypertrophy, atrophy, and tubercle. 2d. The results of inflammation. 3d. Organic changes resulting in modification of the relative disorder of the proportions of their constituents. 4th. Bony growths or tumors.

### SECTION I.

#### MODIFIED NUTRITION.

##### ? 1.—Hypertrophy of the Bones, or Hyperostosis.

The bones, like the soft parts, may acquire that increased volume which has been designated as hypertrophy, p. 70. This hypertrophy in bone, like the same condition as seen in the soft tissues, is in many cases the result of slight inflammatory action, either of the proper bony tissue (Ostitis) or of the periosteum, (Periostitis,) and may appear gradually without pain, and without any evidence of inflammation.

Hypertrophy of a bone may manifest itself in an increased thickness of its outer compact layer, the medullary cavity, latter named portions, cancellated texture, and Haversian canals remaining the same. Or all these may diminish in size, and finally disappear, the compact bony tissue encroaching also upon the medullary areola throughout the cancellated portions, so that the bone becomes indurated and preternaturally heavy, (Sclerosis.) Lastly,

(671)

hypertrophy may be manifested in the length of the bone by increased deposit in its extremities, though this is comparatively rare.   Cases are, however, recorded of this condition affecting especially the long bones of one of the lower limbs to such an extent as to produce an awkwardness of gait, from the unequal length of the other limb, a specimen of a marked character being now in my cabinet.

## § 2.—Atrophy of the Bones.

**Atrophy** may involve parts of bones, whole bones, or even large portions of the skeleton.

That of a purely local character may result from the pressure of tumors, as where the bodies of the vertebræ are excavated and reduced materially in size by the pressure of a thoracic or abdominal aneurism, or where the bones of the face are modified and reduced to a mere bony shell by the pressure of a tumor of the antrum.   More extensive atrophy also results from causes which impair the normal nutritive conditions of one or several bones; thus in cases of anchylosed, or paralyzed limbs, and after long-continued or exhausting healing processes, as in tedious cases of fracture, or diseases of the bones, as caries, atrophy of the involved bones may occur, their texture remaining normal, but their thickness and even their length diminishing, and the medullary canal contracting.*   The bones of the old are also liable to a condition designated as **Senile Atrophy,** in which, with very trifling loss of size, or without actual diminution in bulk, their medullary cavities increase in capacity, the bone losing strength, and becoming preternaturally brittle, from an excessive proportion of lime salts.†   This constitutes one of the categories which has been included under the designation fragilitas ossium, as will be hereafter alluded to.   But, besides the above-mentioned instances, there are several disorders of the bones which have received separate consideration by surgical writers, and which are essentially atrophic processes.   Of these, rickets, mollities ossium and fragilitas ossium are the most important, and will be specially considered.

## § 3.—Tubercles of the Bones.

Tubercles having all the anatomical characteristics of those met with in the soft parts, and pursuing a similar course, are frequently encountered in the bones, occurring most frequently in childhood and about the era of puberty, though also noted in adult life, and even in old age.   The tubercular formation in bone is most apt to be seated in the cancellated tissue, as in the bodies of the vertebræ, where it constitutes the starting-point of many cases of antero-posterior curvature of the spine; in the cancellated tissue of the tarsal and carpal bones, as in the scrofulous caries of the older surgeons, and in the cancellated tissue at the extremities of the long bones.

Tubercles in bone may be seen in separate discrete masses, of small or very moderate size, (encysted tubercles of Nélaton,) or they may be infiltrated through a considerable extent of tissue, in a manner analogous to what is seen in the soft tissues, (tuberculous infiltration.)

**Encysted tubercles** of the bones present themselves as opaque, white, yellowish-white, or grayish masses, which may be quite small or large, though

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* Concentric Atrophy, Rokitansky,  vol. iii. p. 135.
† Eccentric Hypertrophy, Rokitansky, vol. iii. p. 135.

still generally of very moderate size—from two or three to fifteen or twenty lines in diameter.* They are most frequently imbedded in cancellated tissue, and are usually surrounded by a more or less distinct cyst. After a time the tubercle begins to soften, till finally it is broken down into a cream-like pulp, or a thin, flocculent, purulent fluid, which tends to escape externally, finding its way sooner or later to the surface, where it discharges, leaving subsequently a fistulous opening, from which a variable quantity of thin liquid, having the characters heretofore assigned to scrofulous pus, flows constantly, continuing to discharge for an indefinite time; though sometimes granulations will sprout from the walls of the emptied cyst, and, gradually closing it, lead to an ultimate cure.

**Tuberculous infiltration,** according to Nélaton,† may present the characters belonging to *gray* or to *yellow* tubercle. The first of these varieties degenerates into the second, and this undergoes softening, and breaks down into a purulent liquid with destruction of all the bone texture involved in the infiltration. The liquid resulting from this softening process, mixed with pus derived from inflammation of the surrounding parts, and containing, with cheesy flocculi, numerous sequestra, of larger or smaller size, tends to escape externally, as was the case in the encysted variety. This variety of tubercle is often confounded with caries, which it resembles somewhat in the extended destruction of bony tissue to which it gives rise. It may occur in the cancellous tissue of any of the bones, but is most common in bodies of the vertebræ and the bones of the leg and foot; in which, according to Nélaton,‡ it is more frequent than the encysted variety, and is the cause of very marked antero-posterior curvature, in consequence of the extensive destruction of the bodies of the vertebræ which it induces, as will be subsequently seen.

When caries supervenes on the deposit of tubercles, the diagnosis can only be made in connection with the evidence offered of the tuberculous diathesis; tubercles, in many cases, being the starting-point of caries as well as of ostitis and bony ulceration.

As the bones are mainly dependent on the periosteum and endosteum for their vascular supply, as well as for their formation and nutrition, any disease of their substance is liable so to modify the normal action of these membranes as to create disease in them, and especially in the periosteum. The disordered action of these membranes must, therefore, be borne in mind in studying all the diseases of the bones, and will be first presented for consideration.

## SECTION II.

### INFLAMMATION OF BONE AND ITS MEMBRANES.

#### ¿ 1.—Periostitis.

**Etiology.**—Inflammation of the periosteum, or *periostitis*, which is a sufficiently common disorder, is so often connected with ostitis as to either precede or follow the development of the latter. The causes of periostitis may be local mechanical injuries, as blows and wounds, or the extension of ulcers, or it may result from the constitutional causes that affect fibrous tissue, as rheumatism, gout, syphilis, tubercles, cancer; but "in most cases

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* Recherches sur l'Affection Tuberculeuse des Os, par A. Nélaton, D.M.
† Loc. cit.   ‡ Loc. cit.
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the circumscribed abscess in bone cannot be traced to local injury or other distinct cause."*

**Seat.**—Periostitis may occur in any of the bones of the body, but is most common in the long bones, or in such as are superficial, and therefore more directly exposed to local injuries; such as the tibia, clavicle, femur, sternum, and cranial bones.

**Result.**—Periostitis, like all other inflammations, may terminate by resolution, or by the production of lymph and hypertrophy, or in pus, ulceration, mortification, or sloughing. It may also, like other inflammations, be either acute or chronic in its character. When examined at different periods, an inflamed periosteum will be found to offer all the usual appearances consequent on inflammatory action elsewhere; such as increased vascularity or redness, and exquisite sensibility, while subsequently we can note such results of inflammation as create and organize lymph, or tend to the formation of pus, with ulceration and other degenerations of tissue.

**Symptoms.**—The existence of *acute periostitis* is first shown by pain in the course of the bone, this being generally increased on pressure. In its earlier stages, it is, however, difficult to distinguish periostitis from inflammation of the bone itself. After the development of pain, the part soon becomes swollen and hot, the swelling being circumscribed, firm, and resisting, seldom attaining any size, but softening slowly and suppurating, though it gives little evidence of fluctuation. As suppuration is developed, the pain becomes more severe, owing to the effusions being circumscribed, and stretching the inflamed and closely-adherent membrane. Fever is, therefore, often present at this period, and accompanied with great restlessness, insomnia, and the other signs of sympathetic excitement. In *chronic periostitis*, the progress of the disorder is less rapid, the tendency of the inflammation being rather to the production and organization of fibrin than to suppuration. Consequently, chronic periostitis more frequently results in thickening of the membrane and hypertrophy of the bone than in abscess.

**Prognosis.**—The result of periostitis is usually favorable if promptly and properly treated, but otherwise it is very apt to be followed by such diseased action in the proper bony tissue as may result in ostitis, caries, or necrosis.

**Treatment.**—The indications for the treatment of periostitis are the same as those required in other inflammations of fibrous tissues, the means being varied occasionally, in accordance with the peculiar action of the cause which produces it. In the acute variety, the ordinary local antiphlogistic measures will usually be demanded, as leeches, cups, the warm water-dressing, with anodyne frictions, such as those made with aconite and lard in the form of ointment, or with the saturated tincture of aconite, belladonna, or opium. At the same time, free purging will prove useful. When there is reason to think that pus has formed beneath the periosteum, this membrane should be incised by cutting directly down to the bone, so as to give free vent to the matter, and prevent its accumulation from elevating the membrane from the bone, and thus impairing the vitality of the latter. In these cases, the pain will also be promptly relieved by the incision permitting the expansion of the previously confined liquid effusions, and so great has been this relief that Velpeau, Malgaigne, and others have advised that it should be made in all cases of acute periostitis at an early period, or before there is evidence of suppuration.

It has also been proposed to divide the periosteum subcutaneously, in order

* Stanley, op. cit. p. 48.

to guard against an alleged tendency of the bone to become carious when fully exposed, but Mr. Stanley is of the opinion that such an operation would not suffice to relieve the tension, and that it would not even remove the congestion of the blood-vessels.*

After the evacuation of the matter which has formed beneath the periosteum, the wound should be treated on the general principles already detailed in connection with abscesses.

In chronic periostitis, there is a marked tendency to the production of lymph, which, becoming organized, soon results in a permanent thickening of the part, which is designated as a *Node*. It is also apt to result in hypertrophy of the bone, and thus serves as one of the exciting causes of certain bony tumors, as exostoses or osteophytes.

In the early stages of chronic periostitis, the application of repeated blisters is sometimes exceedingly useful, anodynes being also required for the relief of pain. But as the chief source of the trouble is the production of lymph, nothing serves so good a purpose as the use of the iodide of potash or of mercurials, both internally and externally, pushing them far enough to modify the nutritive action in the tissue, this being evidently due to their action as stimulants of the local circulation—both, if long continued, acting as irritants. A treatment thus conducted will often check the progress of the disorder, and prevent the development of bony tumors, by bringing about a more healthy condition. The treatment of chronic periostitis, as the result of syphilitic disease, has been already alluded to in connection with syphilis.

### § 2.—Inflammation of the Bones.

Inflammation of the bones, or **Ostitis**, may ensue on various causes, and result in suppuration, ulceration, etc.

1. **Suppuration in Bone**, like that seen in the soft tissues, varies much in extent, being either circumscribed or diffused throughout the medullary canal.

**Symptoms.**—The symptoms of suppuration in bone are often difficult to recognize, though generally the circumscribed abscess supervenes on an injury, that sooner or later is followed by deep-seated, aching pain, which is augmented by jars of the limb, and especially marked at night. The skin over the seat of pain at first retains its natural appearance, but as the bone swells, it becomes red, vascular, and edematous, with the symptoms of periostitis before detailed ; the persistence of these symptoms, without evident suppuration, showing, however, that the chief disorder is deep seated. As the abscess progresses, the cancellated tissue becomes distended, the bone enlarges, and we have the changes hereafter noted in connection with the progress of caries.

**Diagnosis.**—The diagnosis of suppuration in bone is very difficult, being usually decided by a careful history of the case, and by the lapse of time rendering the existence of the disorder probable. The only positive diagnosis that can be made at an early period is one obtained by perforating the bone and evacuating the pus.

**Prognosis.**—The prognosis of abscess in bone is favorable, especially when it is promptly evacuated by perforating the compact substances over it with a trephine.

2. **Ulceration in Bone**, in its general characters, resembles closely ulcera-

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* Stanley, op. cit. p. 278.

tion in the soft tissues, being attended by molecular death of the portion of tissue involved, and characterized in its repair by the formation of granulations, and a marked disposition to bony cicatrization. Ulceration of bone may result from simple periostitis, or ostitis, or from tuberculous and cancerous deposit, or from syphilis. Like ulceration in the soft tissues, we note two varieties in the bones : that corresponding with the healthy ulcer, being true ulceration of bone, and that resembling the irritable and unhealthy ulcer, being in bone designated as Caries.

**Symptoms.**—Ulceration in bone presents evidence of an interstitial loss of substance that leaves an irregular, porous surface, a more or less ichorous pus, thickening of the adjacent periosteum, granulations that bleed often readily, with a thickened edge of the periosteum and integuments, the ulcer in the latter being of the chronic variety. As ulceration of bone is sooner or later followed by ulceration of the soft tissues covering it, we will also find either an open ulcer of the skin of the irritable variety, or a sinus, with fungous granulations, and a minute orifice in the centre of each teat-like granulation, such as is hereafter described as attendant on necrosis. As resulting from arthritis, ulceration of bone will be alluded to in another place. When ulceration of bone is checked, the reparative action, like that of the soft tissues, is the result of the increased vascularity and modified cell-action of the adjacent tissues. Thus, in ulceration of the cancellated tissue of bone, the Haversian canals become more vascular, are filled with osseous matter, are solidified or agglutinated, and result in the formation of a solid substance, analogous in its relative appearance to the inodular tissue—that is to say, it is denser in its structure, at first more vascular, and lastly less so than the normal bone, and always recognizable as a cicatrix of bone. Ulceration of the compact tissue of bone is seldom healed by the formation of a new compact layer of bone. As the periosteum is here usually destroyed, the reparative action is mainly accomplished by the Haversian ossicles and canals, and hence there results a depression, over which the skin forms, so as to leave evidence of loss of substance, the space thus left beneath the skin being filled with fibro-ligamentous or areolar tissue of a dense character.

**Treatment.**—The best treatment of bony ulceration is the antiphlogistic, and especially the application of mild stimulating washes, alternated with mucilages. Stimulants applied to true ulceration of bone are liable to augment the action and develop caries, or the sloughing ulcer of bone.

## SECTION III.

### OSTITIS.

**Ostitis,** or inflammation of the proper structure of the bone, especially its cancellated or areolar tissue, is a disorder which is generally found in the young or middle aged, and in the long bones, especially the tibia. At its commencement, it is difficult to recognize ostitis as a distinct disorder; and as it sometimes results in ulceration, it has not unfrequently been alluded to as identical with caries. But every inflammation of a bone does not result in ulceration, and there are, therefore, certain changes which can only be justly regarded as the effects of the inflammatory process as modified by the bony structures. Thus, inflammation of a bone, by creating increased vascularity, may result in a deposit of osseous matter exterior to the true compact layer of the bone, so as to create spiculæ and great deformity as well as loss of motion in a joint, Fig. 311, or in hypertrophy of either its compact or cancellated tissue, or both, rendering them more di-

lated, and expanding the lamellæ of the compact as well as the cancellated tissue, so as to produce a marked augmentation, either in a part or in the entire volume of the bone, Fig. 312    Or suppuration and a true abscess of the cancellated tissue may ensue, Fig. 313, and be followed by the ordinary results of abscesses elsewhere ; but as the tissue, which becomes distended under the influence of an abscess in a bone, is hard and unyielding, the sides of the cavity do not collapse when the pus is evacuated, as was the case in abscess of the soft tissues.

Fig. 311.                          Fig. 312.                          Fig. 313.



Fig. 311.—Chronic Ostitis, marked changes in the exterior of the tibia and fibula.
Fig. 312.—A view of the ordinary enlargement of both the compact and cancellated Tissue of a Tibia as the result of ostitis.
Fig. 313.—A representation of the condition of the Head of the Tibia after the formation of a chronic abscess, the bone being much thickened as well as enlarged around the cavity.

In examining by section a bone which has been acutely inflamed, there will generally be seen a certain amount of bloody serum in its cancellated tissue, with a diminution of its natural hardness, the structure being soft and somewhat pulpy, while after the development of an abscess a circumscribed cavity surrounded by increased vascularity will often be found.

**Etiology.**—The causes of ostitis may be the extension of inflammation from the periosteum, or the direct application of irritants, as blows, caustics, etc., or it may ensue upon the deposition of tuberculous or carcinomatous matter, which passes through the stages of these deposits elsewhere, thus inducing inflammation of the bony tissue in the progress of the deposit toward the surface. Tertiary syphilis, by developing an internal periostitis, is not unfrequently a prominent cause of ostitis.

**Symptoms.**—At the commencement of ostitis, the patient may complain of deep-seated and indescribable pain, which is increased by jars or violent movements of the bone ; this pain being often permanent for many days or weeks without its source being recognized. Then the pain becomes

marked on pressure, the part swells, the integuments become livid, hot, and swollen, and there is an evident extension of the inflammatory action from the cancellated tissue of the bone to the periosteum and the other tissues around it, the case being subsequently characterized by the symptoms recently described in connection with periostitis, abscess, and ulceration of bone.

**Diagnosis.**—The diagnosis of ostitis is usually very difficult; but its presence may be suspected from the deep character of the pain, the slow progress of the disorder, the absence of the circumscribed swelling of periostitis, and the peculiar seat of the suffering, as described by the patient.

Fig. 314.



ENLARGEMENT AND CONVEXITY OF THE TIBIA FROM OSTITIS.— In this patient, this limb was half an inch longer than the other. (After Nature.)

**Prognosis.**—The ordinary result of acute ostitis is the formation of an abscess, with ulceration or caries, or necrosis. The prognosis is therefore favorable as regards life, though the evils which ensue upon the evacuation of the abscess, or the development of caries or necrosis, will be subsequently alluded to. Chronic ostitis, however, more frequently develops such a hypertrophy of the bone as creates a marked elongation of the limb, the bone becoming convex forward in the efforts of nature to obviate the evil, Fig. 314. It is not unfrequently attended by bony ulceration.

**Treatment.**—The treatment of acute ostitis should consist in the use of local and general anodynes, with the application of counter-irritants to the part, or the free use of warm emollient dressings; after which stimulating plasters and the means directed for the relief of periostitis will be demanded. When the symptoms of an abscess in the long bones, especially the tibia, are marked, (as intense pain, swelling, fever, as before mentioned,) the surgeon should cut down and expose the bone at or near the seat of the pain, perforating the bony tissue, as far as the medullary canal, by means of a trephine, so as to give vent to the pus, a mode of treatment which has sometimes proved most useful, and is not followed by any serious consequences in the event of an error of diagnosis, though caution should, of course, be exercised in the examination of the case before resorting to the operation.

## SECTION IV.

### CARIES.

**Caries** (κειρω, to abrade) is a peculiar condition of the bone, which may be defined as the ulceration or solution of continuity in this structure which is the result of unhealthy inflammatory action and interstitial absorption. It is especially characterized by the destruction and softening of the *cancellated tissue*, resembling in this respect the sloughing of the areolar tissue and the condition of the soft parts described under the head of the Irritable and Phagedenic Ulcer of the soft parts. Caries differs from ulceration of bone in the same way that the simple healthy ulcer of the soft tissue differs from the irritable ulcer. In ulceration of bone there may be, as stated, a partial loss of substance as the result of an abscess; but the tendency of this ulcer is to heal by the deposit of lymph and the formation of healthy granulations, while in caries the tendency of the diseased action

is to spread, the dead portions being thrown off in scales or particles, like the minute shreds or sloughs of the soft tissues, while the reparative effort is unable to check the disorder for some time, the progress of the disease being characterized by very much the same symptoms as were described in connection with the irritable ulcer of the soft parts.

**Etiology.**—Caries may be created by any cause which will develop unhealthy inflammation in the cancellated tissue of a bone. Thus, it may ensue on periostitis, ostitis, ulcers of the soft tissues, which destroy the periosteum, as well as upon syphilitic or mercurial irritation of the fibrous structures, when accompanied by a diminution of the action of the tissue cells in forming the lymph, by which nature checks the progress of inflammatory action.

**Symptoms.**—Like ulceration of bone, caries is usually preceded by ostitis, and is shown by the same symptoms as were detailed in connection with it, such as deep-seated pain, inability to sleep, enlargement of the part, tenderness on heavy pressure, loss of appetite, and fever, while the skin, which at first preserves its natural color, subsequently becomes hot, swollen, livid, and ulcerated in various points; these ulcers being accompanied with depression of the edges from the loss of the subcutaneous connective tissue. As soon as the integuments give way, there escapes through those ulcerated points a thin, grayish sanies, mingled with shreds of the subcutaneous connective tissue, as well as with little scales of the cancellated tissue of the bone. On passing a probe into this opening, it will prove to be the orifice of a fistulous canal, at the end of which the bone will be felt, soft, porous, and broken down into a semi-pulpy or lardaceous structure, from which dark, venous blood will escape under the action of the probe, this examination being often exquisitely painful to the patient. As the disease progresses, the matter becomes more brown or greenish in its tint, has a peculiarly offensive odor, and is so irritating that it develops inflammatory action on that part of the integuments over which it flows; hence it is not unusual to find *eczema* scattered around the neighborhood of the integuments which cover a carious bone. When the caries attack deep-seated bones, as those of the vertebræ and pelvis, its course is much more tardy, the matter escapes with difficulty through the superimposed soft parts, travels therefore along the sheaths of muscles, and is apt to discharge in the line of the groin or loins, creating such symptoms as have been alluded to in connection with the subject of cold abscesses, hectic or the typhoid condition there alluded to often being established. The constitutional disturbance is also very marked when caries invades the articulating surfaces of bones, as in the ankle and tarsal or carpal articulations. According to Becquerel and Rodier,* a marked diminution may also be noted in the chemical constituents of bones affected by caries, showing the influence of the general as well as the local disturbance. Thus, in caries, there is—

1. A notable diminution in the proportion of the phosphate of lime.
2. A slight increase of the carbonate of lime.
3. No change in the phosphate of magnesia.
4. No change in the normal relative proportion of the gelatin, though the latter is slightly altered in its character.
5. A considerable increase in fatty matter.

**Diagnosis.**—The disease with which caries is most apt to be confounded is necrosis, and the distinctive signs between them will, therefore, be given hereafter.

**Prognosis.**—The prognosis of caries is generally serious, the result de-

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* Traité de Chimie Pathologique, p. 543, et supra.

pending especially on the age and constitution of the patient.    When developed by injury in the young and healthy, the progress of the destruction may be checked after a time, by the simple efforts of nature, leaving a condition somewhat analogous to the indolent ulcer of the soft parts.  But when the caries is the result of syphilitic, tuberculous, or mercurial contamination, and when it is seated near or in the bones of an articulation, as those of the tarsus or carpus, it will be very apt to exhaust the patient's strength, and cause death, unless arrested by amputation of the limb.    When caries is superficial, and in bones which have but a limited amount of cancellated tissue, as those of the cranium, the prognosis would be less serious, the disorder being ultimately amenable to treatment.

**Treatment.**—The general indications in the treatment of caries are :  1st. To remove, if possible, the cause of the disorder.  2d.  To bring about a healthy condition in the diseased bone, and favor the cicatrization of the carious ulcer.    These indications are to be fulfilled on general principles ; thus, if caries is the result of syphilitic or tuberculous contamination, administer such remedies as are appropriate to these conditions, while the local treatment should vary in accordance with the nature of the part affected.  In all cases the exterior inflammation should be checked by the means directed in the general and local treatment of inflammation, while the diseased bone should be removed by instruments, as scoops, gouges, etc., if it is so situated as to be anatomically safe to do so.  When the carious surface is exposed, and the reparative process is not readily established, some modification of the local action may be obtained through the stimulus of topical applications, as alkaline ointments, which will occasionally modify in a marked manner the ichorous character of the discharge, or more marked stimulants, as the tinctura ferri chloridi or the nitric or muriatic acid carefully applied on lint for a few moments, or caustic solutions, as of potash or chloride of zinc, while the actual cautery has sometimes been freely used with advantage, the separation of the eschar being followed by the development of healthy granulations.   In fact, caries, like the irritable ulcer of the soft parts, requires that the destructive action should be checked, and the reparative effort established ;  but whether this is to be effected by exciting or reducing the vascular action of this part, must depend on the peculiarity of the case.  As a general rule, when caries is sufficiently superficial and limited in its extent, the best plan of treatment is resection of the diseased part, either by scooping it out until sound, healthy tissue is reached, or by cutting off the diseased end of the bone, in the manner that will be shown hereafter.*    The most important locations of caries is the bones of the cranium and vertebræ, and in the carpus and tarsus.

### ¿ 1.—Caries of the Cranium.

Caries of the bones of the head may affect any part of the cranium, though most liable to be developed in the upper and lower portions, as the frontal, parietal, and occipital bones, the temporal and sphenoidal generally escaping.

**Etiology.**—Caries in the bones of the cranium is usually the result of syphilitic or mercurial poisoning, and ensues upon periostitis or pericranitis, which, by creating ostitis, gradually develops the unhealthy action of carious ulceration.

**Symptoms.**—After the existence of the symptoms of nodes—as described under the head of periostitis—a soft fluctuating tumor forms beneath the scalp, which, when opened, either by ulceration or by puncture, gives exit to

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* See vol. ii.

some healthy-looking pus, but is soon followed by the sanies of carious bone, as previously described. This opening is now apt to spread until it creates an ulcer of the size of a shilling and upwards, and, owing to the peculiar character of the integuments, is liable to develop erysipelas. In the centre of this ulcer the outer table of the skull is usually found in a necrosed condition, until, as the compact lamina is thrown off, the diplöe exhibits the ordinary condition of caries as seen in the cancellated tissue of other bones. If the disease progresses slowly, as it is apt to do, the edges of the ulcerated scalp may become thickened and inverted, sometimes also becoming closely adherent to the subjacent pericranium. At the same time the patient will suffer pain and all the symptoms of inflammatory fever.

**Diagnosis.**—The superficial character of the parts affected renders the diagnosis easy.

**Prognosis.**—Caries of the bones of the cranium, when limited, is more readily susceptible of cure than any other seat of caries; but as it is generally the result of syphilitic ostitis or pericranitis, the disease is apt to invade a considerable portion of the bone, and to require either many months for its cure, or ultimately exhaust the patient by the hectic fever which supervenes. The cicatrix that remains after the existence of caries of the cranium is always depressed, and deprived of hair, so that it generally constitutes a marked deformity.

**Treatment.**—In the treatment of caries of the cranium constitutional remedies—especially the use of the iodide of potash—often exhibit considerable power in checking the phagedenic tendency of the disorder. When the disease is circumscribed, the best local applications are the mineral acids, painted on the diseased bone after the scalp has been shaved around the ulcer, and its edge protected from the action of the acid by covering it with simple cerate spread directly on the scalp. The removal of the diseased portion of bone, as far as the internal table, is also highly serviceable, the remaining ulcer of the integuments being treated on general principles or cured by a plastic operation.*

### § 2.—Caries and Tubercles of the Vertebrae.

Under the name of **Caries of the Vertebræ,** the older surgical writers described such a condition of the vertebral column as resulted in giving way of the bodies of the bones, in an encroachment on the natural calibre and line of the spinal canal, and in such a deviation from the natural line of the back as makes a marked deformity, generally in an antero-posterior direction. This deformity, by causing a prominence of the spinous processes of the vertebra, creates a lump, and hence is popularly known as "hump-back," or "broken-back," the bones being supposed to be fractured. As the deformity consequent on caries is liable to be confounded with two other diseased conditions of the bone, these may be advantageously now presented.

There are two varieties of disease of the vertebræ which may result in curvature of the spine; these varieties being very often confounded with each other. The first is that due to a true caries of the bodies of the bones, in which we have all the changes already stated as characteristic of caries elsewhere; while the second is caused by the deposition, softening, and modification of bony tissue consequent on tubercular deposits in the cancellated tissue of the bones. This latter affection is ordinarily spoken of as "scrofulous disease of the spine," a vague term, which indicates nothing positive

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* See vol. ii.

in regard to the pathology of the disorder, and which is much better expressed by the title of tubercles of the vertebral column. In both the symptoms are at first somewhat indefinite, while in both there may be such changes of structure as will involve the spinal marrow. Thus, after a fall or some other accidental cause capable of developing inflammation, the patient will

Fig. 315.                    Fig. 316.



Fig. 315.—A view of the Antero-posterior Deformity or Curvature of the Spine, often seen as the result of *caries* of the bodies of one or two vertebræ.
Fig. 316.—A view of the Deformity caused by a Lateral Curvature of the Spine as created by the excessive *action of the muscles* on the right side.

experience a constant deep aching pain in the part, which is subsequently followed by symptoms that are due to alterations in the cavity of the spinal canal and secondary disorder in the spinal marrow or its membranes, all of which may be caused either by caries of, or tubercles in the vertebræ, and should, therefore, be separately studied.

1. **Caries of the Vertebræ.**—Caries of the vertebræ generally affects the bodies of the bones, causing them to break down by their front faces, owing to the direct pressure of the weight of the head and shoulders on the column, and the general tendency of the column to flexion anteriorly. The pus which attends the progress of the disorder passes, therefore, either beneath the anterior vertebral ligament until it reaches the origin of the psoas magnus muscle, whence it travels beneath the sheath of this muscle toward its insertion, opening in the groin and constituting "psoas abscess;" or it follows the posterior line of the vertebræ and the sacro-lumbalis muscle to a point just above the posterior edge of the brim of the pelvis, thus inducing "lumbar abscess." Caries may affect the bodies of any of the vertebræ, but is most commonly met with in those of the dorsal or lumbar region, being rare in the neck. As the reparative effort is imperfect, the entire bodies of one or two vertebræ may be removed by the disease, in consequence of which the weight of the head and shoulders causes the approximation of the adjacent vertebræ, and creates a deformity like that shown in Fig. 315, nature subsequently solidifying the part by anchylosis, the inflammation of the periosteum leading to the deposit of new bony matter.

Fig. 317.                           Fig. 318.



Fig. 317. Caries of the Vertebræ, showing the destruction of the bodies of two of the dorsal vertebræ, the approximation of the adjacent ones by the weight of the head and shoulders acting on the upper part of the column, and the prominence in the back caused by the spinous processes.

Fig. 318. A VIEW OF THE ULCERATION caused by the softening of Tubercles in the Bodies of the Vertebræ, showing the amount of the destruction of the bones, the epiphyses remaining perfect.—1, 1, 1. Points where the tubercles have softened and induced the death of the cancellated tissue. The bony spines which strengthen the parts after the escape of the tubercles are also shown. (After Nature.)

2. **Tubercles of the Vertebræ.**—This disease, consisting in a true tubercular deposit similar in all its characteristics to tubercular deposits in the lungs and elsewhere, is usually the result of the tuberculous, or as it was formerly called, the scrofulous diathesis. Tubercles of the vertebræ are generally deposited in the cancellated structure of the bodies of the bones, where they may be found either as little distinct masses, or generally infiltrated throughout the cancellated tissue, the latter being of the miliary form, and analogous to miliary tubercles in the lungs, and when once deposited, pursuing the course already alluded to.

Tubercles, when deposited in the cancellated structure of the vertebræ, act like any other foreign body, by inducing congestion, inflammation, and suppuration in the surrounding tissues, and ulceration of the bone being thus induced, little morsels of the tubercle are cast off mixed with the pus, and are discharged externally, mingled with the purulent fluid. The pus of the bony abscess which forms around the softened tubercle does not travel directly to the surface of the vertebra through the cartilage which covers its epiphysis or articulating surface, probably on account of the great vascularity of this part, allowing a free effusion of lymph to take place, so as to limit the extension of the abscess in that direction, but it escapes by perforating the body of the vertebra anteriorly, Fig. 318, destroying a portion of the bone, which is quite limited as compared with the destruction caused by caries. After passing out beneath the anterior vertebral ligament, it takes a course downward, as the matter from caries did, between the ligament and the vertebræ, so as to point below in the form of lumbar abscess, though most frequently the discharge is not so profuse as that created by caries.

Tubercles of the vertebræ, as thus briefly described, are to be regarded rather as evidences of a peculiar diathesis, or as the result of peculiar con-

stitutional disturbance, than as a complaint resulting from external violence
or excited by it. And the recollection of this fact will often aid the surgeon
materially in diagnosing this disorder from caries, the latter being often—in-
deed, generally—the result of external violence. The tendency of caries, it
should be remembered, is to spread, to involve neighboring parts, and grad-
ually to destroy the whole bone; while the progress of a tuberculous abscess in
the bone is to a discharge of its matter and the formation of a simple ulcer,
the tendency of which is toward reparation, though this is generally ren-
dered of no effect by the fresh deposits of tuberculous matter in the neigh-
borhood, which runs a similar course and thus keeps up and propagates the
disease. Tuberculous deposits in the vertebræ seldom, however, cause the
destruction of substance or the deformity that follows caries, the upper and
lower plates of the affected vertebra assisting in preventing the caving in
of the bone as shown in Fig. 318.

**Symptoms of Spinal Curvature from either of these Disorders.**—After
the existence of caries or tuberculous disease of the vertebræ, the symptoms
of spinal curvature may be arranged under two distinct heads: the first
including those which precede the deformity, and are due to the extension
of inflammatory action to the contents of the spinal canal; the second em-
bracing those subsequent to its production, as the displacement of the spi-
nous processes, compression of the spinal cord, etc.

1. **Of the Symptoms which precede the Actual Occurrence of any devi-
ation from the Proper Line of the Spine.**—When the affection of the spine
is due to disease of its bones, the patient complains first of a certain amount
of pain in the part, this pain being heavy, deep seated, and aching. There
is, moreover, tenderness upon pressure, and this tenderness will very often
be found to be limited to certain spots, which spots are generally noted in
the dorsal or lumbar vertebræ, though occasionally seen in the case of the
vertebræ of the neck. Soon after this the patient begins to experience a
sense of weariness in the back, with an indisposition to exercise, and after
exercise suffers more severely from the dull, heavy, aching pain already
alluded to, especially when that exercise has been accompanied by some
amount of accidental jarring of the spine, such, for example, as having made
an incautious step when walking, or taken a long step in descending from a
carriage, etc. Under these circumstances, the patient soon assumes the
horizontal position, as he obtains in this way temporary relief by taking the
weight of the head off the spinal column. The pain, however, returns so
soon as he again becomes erect; and as this condition may continue for
many weeks, he is often said to have "a weak back."

Thus far, the symptoms just detailed apply equally to disease of the bones
arising from tubercles, as well as to that which is the result of caries. But
certain differences can now be noted which will point out with more or less
certainty the special character of each disease. Thus, if the pain be due to
a tuberculous deposit, there will be more or less evidence of the tuberculous
diathesis in the general appearance of the patient and in the general symp-
toms of the case, with more or less tendency to diarrhœa, or to cough,
according as the irritation also affects the mesenteric glands or the lungs,
either of these being symptoms which are not usually present in caries of
the spine.

2. **Symptoms consequent on the yielding of the Bodies of the Vertebræ.**
—When the disease has gone so far as to break down the bodies in the ver-
tebræ, whether due to tuberculous or carious disorder, such changes will be
noticed as are directly connected with loss of substance; thus, the bodies of
the vertebræ will give way, and the spinal column will fall forward, pro-

ducing more or less antero-posterior deformity, and the conditions to which the term **hump-back** is ordinarily given.    If deformity goes on to such an extent that the curvature results in more or less compression of the spinal cord, paralysis will ensue to a greater or less extent, and if the curvature be in the cervical vertebræ the termination will generally be death.

As the yielding of the vertebræ progresses, more or less change will be noticed in the relative position of the ribs, with alteration in the cavity of the chest, the result of which will be difficulties in respiration, shortness of breath, dyspnœa, etc.    At the same time there will be changes in the normal condition in the circulatory organs, as shown by palpitation of the heart, etc.

The position which the patient most frequently assumes is also quite characteristic of disease of the bones; thus, when seated, he sits doubled up with his knees toward his chest, and when he walks his motions generally indicate more or less loss of power in the lower extremities, tripping over the slightest obstacle, and becoming much fatigued after short walks.    As the disease progresses, other signs connected with loss of nervous power become apparent, the patient losing his control over the sphincters of the bladder and anus, in consequence of which the urine and feces are passed involuntarily, precisely as happens in paraplegia from any other cause, while the functions of digestion are weakened, costiveness, flatulency, and eructations showing the disordered action of the muscular coat of the alimentary canal.

**Diagnosis of Spinal Curvature from Diseased Bone.**—It is a matter of some importance in regard to the treatment of the complaint, to be able to make a diagnosis between caries and tuberculous disease of the spine, as the treatment which is perfectly appropriate to the one will be useless if not injurious in the other, and attention to the signs above given as peculiar to tubercle and caries will generally suffice.    The symptoms just described are also liable to be confounded in females with an apparently similar condition, to wit, neuralgic irritation and spinal tenderness, though this special condition is usually the result of uterine disorder.    This neuralgic irritation of the spinal column may, however, be diagnosed from the diseases under consideration, by the fact that pressure rather diminishes than increases the uncomfortableness or pain in neuralgia, and in some cases affords positive relief.    The diagnosis from lateral curvature, or that due to muscular distortion, can be made with readiness, from the fact that, in muscular distortion, the curvature is generally **lateral** instead of **antero-posteriorly**, while the symptoms described as due to tubercles or caries are absent in lateral curvature, such as pain, paraplegia, etc., as will be subsequently shown.

**Prognosis.**—The prognosis of spinal curvature, whether due to caries or tubercles, should be guarded, the disease being a slow one, and if its progress be not arrested, resulting in serious permanent organic changes of the bones of this portion of the body.    The cure, when it can be accomplished, is only to be effected by means of anchylosis, a process always tedious and uncertain, but which sometimes occurs, *post-mortem* examination occasionally revealing the vertebræ fused together by true bony matter.    The patient, therefore, even under the most favorable circumstances, should not be encouraged to expect a cure before twelve or eighteen months; while the deformity, if well marked, will always continue, though it may be slightly modified by judicious treatment.

**Treatment.**—In the treatment of spinal curvature, whether due to caries or tubercles, the indications are—first, to prevent displacement and the formation of a curvature; secondly, to pay attention to the patient's general

health, with a view of removing, if possible, the peculiar constitutional condition upon which the local disease often depends. But these indications are to be carried out in different ways, according to the character of the cause which excites the deformity. Thus, if the pathological condition is due to tuberculous deposit, the first duty of the surgeon is to employ such means as will tend to limit the further deposition of tuberculous matter. If, for example, in the earlier stages of the disease some tenderness upon pressure be noticed in the bodies of any of the vertebræ, indicating more or less irritation or inflammation of the parts concerned, it should be treated precisely as we would treat irritation or inflammation elsewhere. Thus, local depletion may be employed with advantage, such as that by means of cups, etc., but care must be taken not to carry these local depletory measures to any great extent, lest, by inducing depression and perversion of the local nutritive action, they result in an augmentation instead of a diminution of the tuberculous deposit.

If the signs of curvature have begun to show themselves, we will find it necessary to take the weight of the head and shoulders from off the spinal column, so as to prevent the pressure of these parts from adding to the congestion in the bodies of the vertebræ at the point where they are most diminished in strength by disease. At the same time it is desirable that fresh air and exercise should be freely permitted and furnished by every means in our power. Now, these two indications may be well carried out, in the case of children, by a frame in which the patient can stand, the weight of the head and shoulders being taken off the column by a band which passes under the chin, while rollers enable the child to propel the apparatus while walking. Its usual designation is a "go-cart."

If the disease is specially seated in the dorsal vertebræ, some such mechanical contrivance may be applied as that ordinarily sold by the cutlers, and which consists of a band of sheet-iron, padded, and covered with leather, Fig. 319, and made to surround the body just above the hips, while bands on each side present a crutch-shaped pad, which, passing under each shoulder, supports the weight of the arms. In some cases the addition of a piece to support the head will prove useful. With such an apparatus, the patient may take gentle exercise in the open air, from time to time, improve his general health, and yet be almost free from the great cause which tends to augment the curvature, to wit: the weight of the head and upper extremities pressing and breaking down the disintegrating cancelled tissue of the vertebræ.

Fig. 319.



A FULL VIEW OF A "SHOULDER-BRACE," OR SPINAL SUPPORT, adapted to the treatment of Curvature of the Spine, when due to disease of the bodies of the Dorsal or Lumbar Vertebræ. The lower band fastens around the hips, while the crutch-like pieces pass under the armpits, and thus take the weight of the upper extremities off the spine. (After Nature.)

While thus furnishing artificial support, the treatment proper to prevent the maturation and development of tubercles should be adopted. Chalybeates, such as Vallet's carbonate of iron or the ferri pulv., may be freely administered, and the whole class of remedies employed, with these patients, which are ordinarily given in cases of tubercular deposits in the lungs or elsewhere.

Benefit is sometimes obtained, in cases of tuberculous deposit in the bodies of the vertebræ, from the use of counter-irritants, and one of the best that can be employed is the gentle application of heat by means of an iron, such as that used for cauterisation with the actual cautery, having a linear edge; dip it in boiling water, and then draw a line along both sides of the spinous processes from one end of the vertebral column to the other. As thus applied the iron will not vesicate, but will thoroughly redden the skin, and is a better irritant than a mustard plaster, blister, or any similar substance.

The means thus briefly described embrace most of those that will be found necessary in ordinary cases, and present the only plan from which good can be expected.

In caries, however, the treatment must be varied, as the condition of things is here entirely different, the bodies of the vertebræ being extensively ulcerated and liable to break down on vertical pressure. It is to this class of patients that the plan laid down by Pott is especially applicable, its object being to allay inflammatory action, and keep all perpendicular weight, as well as flexion, from acting on the spinal column. Antiphlogistic measures, as depletion, purgation, and counter-irritants, are therefore the remedies mainly demanded, these being patiently combined with perfect rest in the horizontal position. If possible, the patient should be made to lie upon his belly, and not allowed to make the slightest exertion. He should also be moderately purged twice a week with the compound powder of jalap, or some similar purgative of the saline class. When this plan of treatment is judiciously persevered in during a shorter or longer period, the disposition to ulceration and breaking down of the bodies of the bones will often be checked, anchylosis will ensue, and the patient recover, though probably with some deformity; but the mode recommended by Pott for the treatment of caries of the spine is, I fear, too often and thoughtlessly resorted to in all cases of disease of the bodies of the vertebræ, whether due to caries or to tuberculous deposit. According to his plan, a seton, or an issue or two, should be maintained upon the back, directly over or alongside any point of tenderness which may be noticed; but this plan is liable to one very serious objection, to wit, that it increases to an inconvenient, if not to an injurious extent, the irritation of the integuments caused by the pressure of the hump or angle of the deformity. The same objection would also apply to moxæ, but with more force. A better mode of employing counter-irritants, if they are to be made use of, either in caries or tubercles of the vertebræ, is to apply them at a distance, say some four or five inches from the seat of the injury. But in tuberculous disease of the vertebræ anything like a drain on the system is apt to prove injurious by weakening the powers of life, and favoring the degeneration of the tubercles.

In order to prevent the patient suffering from the want of fresh air and exercise, during the treatment of caries, a little coach may be made for him, in which he should be drawn about, while he may yet enjoys all the benefits arising from the horizontal posture.

## § 3.—Lateral Curvature of the Spine.

**Lateral Curvature of the Spine** is a distortion of the vertebral column due to muscular action, and unattended usually by any disease of the bones themselves. It is mostly seen in young girls and boys of from five to fifteen years of age, especially in girls who are improperly educated physically.

**Etiology.**—The causes of this disorder are to be found in the relaxing influences of luxurious beds and over-warmed houses; in the ridiculous rules of fashionable boarding-schools, such as those which require growing girls to stand for two or three hours during a recitation, or to use seats without backs, under the impression that the little sufferer will thus acquire grace and an erect carriage; or in the absurd directions of certain writing-masters, compelling the child to sit with one side to the table, thus encouraging the use of one set of muscles. Another very common cause is dressing female children with low-necked dresses, so as to cause them to hitch and turn themselves with a view of keeping up their clothes, thus not unfrequently developing the muscles of one shoulder more rapidly than those of the other. It will also be sometimes found in growing boys, as in those who carry a strap full of school-books on one shoulder, or who work at some trade which compels them to use one side of the body more than the other, such as blacksmiths' apprentices, who blow the bellows, etc. In these cases, the muscles involved are most frequently those connected with the scapula, such as the trapezius, rhomboideus, levator anguli scapulæ, etc. muscles, the tendency of which is to draw the scapula toward the spine, or elevate it, but muscles the action of which would serve equally—one scapula being made a fixed point—to draw the spine from the scapula. In some patients the creation of lateral curvature as the result of muscular action is also favored by a want of firmness in the bones, the latter presenting a tendency toward the condition described under the head of osteo-malacia, or mollities ossium.

**Symptoms.**—The presence of lateral curvature, from these causes, may generally be at once recognized by a simple inspection of the naked back; the true line of the spinous processes of the vertebræ being considered, under ordinary circumstances, so far at least as its lateral inclination is concerned, as a plumb-line. Inspection in the case of lateral curvature will at once show the deviations from this line, these deviations being greater or less in degree according to the point to which the disease has progressed. Usually, it is rare to find disease of the bones in connection with muscular distortion.

As a consequence of the distortion of the vertebral column, changes may also be noticed in the position and relations of the ribs: the length of the chest being sometimes very much shortened on one side, and the distance between the lower rib and the top of the ilium occasionally diminished to such an extent that it may be spoken of as not existing; or the chest may be flattened in its shape, while the cartilages of the ribs and the sternum project, the condition of the "chicken-breasted" being not unfrequently created by this muscular distortion.

**Diagnosis.**—A reference to the symptoms before given as characteristic of caries and tubercles of the vertebræ, and their comparison with those just enumerated, will render the diagnosis of lateral curvature easy. Lateral curvature is occasionally combined with the antero-posterior deformity, though it is rare to find the two thus blended, as I have verified by a careful examination of a large number of specimens.

**Prognosis.**—The prognosis of lateral curvature of the spine should be guarded. If the case is seen early, it may be remedied by judicious exercise of the set of muscles opposite to those which have hitherto been called into play and created the deformity; but the process of cure is a tedious one, and, if the disease has existed any length of time, will generally be but partially successful.

**Treatment.**—The indications for the treatment of lateral curvature are the development, by exercise, by frictions, etc., of the weaker set of muscles; thus, if the curvature has its convexity toward the right side, the muscles of

the left are those the development of which should be attempted. Besides exercise and frictions, the shower bath, cold douche, and electro-magnetism have also proved serviceable by increasing the circulation in the weakened muscles and aiding their nutrition.

Fig. 320.                                                                Fig. 321.
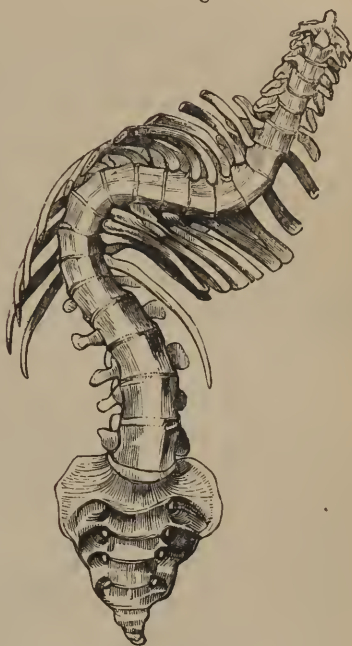


Fig. 320.—A view of the Deformity seen in Lateral Curvature, from an inspection of the back.
Fig. 321.—A view of the Condition of the Vertebræ and Ribs in the same disorder.

An attempt was made some years ago to bring into credit a mode of treating these curvatures by section of the contracted muscles, Guerin, of Paris, having operated extensively in this manner upon all cases of spinal curvatures which presented themselves; but the result has never created any marked professional favor. As a general rule, the bones and ligaments of bad cases have accommodated themselves to their new positions, and few, therefore, can be permanently benefited by such operations.

The same remark will apply to mechanical contrivances, with which the stores are filled, and the power of which is lauded for the cure of this deformity. Usually they are entirely useless, and rather increase the muscular debility. Carrying light weights on the head—as in balancing a book while walking—by developing the muscles, is much more useful.

Another disorder of the vertebræ is that due to congenital deficiency of a portion of the spinal canal, which may now be advantageously alluded to.

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## SECTION V.

### SPINA BIFIDA.

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**Spina Bifida**, or Hydrorachis, ($\upsilon\delta\omega\rho$, water, and $\rho\alpha\chi\iota\varsigma$, the spine,) is a congenital malformation of the spinous processes and posterior part of the vertebræ, in consequence of which an orifice is left, through which the spinal membranes protrude. Sometimes, indeed, the spinal cord itself escapes, though this is by no means generally the case. The disease, as might be supposed from the fact that it is congenital, is generally seen in infants, and those cases upon record in which it is spoken of as first appearing one, two, or three months after birth are generally such as have escaped attention at an earlier period. Most frequently, the child in whom the disease occurs is in other respects well formed, and free from all other deformity except a marked predisposition to hydrocephalus. The formation of the tumor is generally at some point in the lumbar region, and the symptoms are as follows:—

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Fig. 322.

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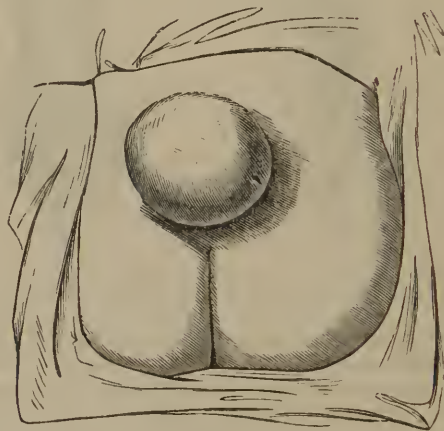
A full view of Spina Bifida of the lower part of the Lumbar Vertebræ. (After a cast from Nature.)

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**Symptoms.**—Soon after birth, there is noticed in the region mentioned a tumor of variable size, which is thin and diaphanous, and evidently contains fluid, Fig. 322. Usually, it is uncovered by the ordinary integuments of the part, or if they cover it, they are sometimes extremely attenuated. If gentle pressure is made upon the tumor, its contents will pass up into the spinal canal, and the swelling disappear more or less completely; but any such effort as this should be made with great caution, for if too violent or sudden pressure be made, the spinal marrow may become involved, and paralysis be induced. The disease is often combined with hydrocephalus, and sometimes with idiocy.

**Diagnosis.**—The diagnosis of this affection from caries, tubercles, or muscular curvature does not present much difficulty, the size of the tumor, its translucency, its position, the age of the patient, and the history of the case being quite sufficient to determine its nature.

**Prognosis.**—With regard to the prognosis, it is unfavorable. The dis-

ease is not readily relieved, and generally terminates fatally, though occasionally cures have been obtained. The child sometimes dies as early as the fifth or sixth month, either by convulsions or from spinal meningitis, after ulceration or rupture of the sac. Some cases, however, are on record in which adult life was reached.

**Treatment.**—The treatment consists in evacuating the contents of the tumor by means of acupuncture needles, after which various plans have been proposed for inducing the adhesion of the sides of the cavity, such as injecting the cavity of the spinal cord with tinct. of iodine in aqueous solution, as will be described in connection with the operations on this region in vol. ii.

## SECTION VI.

### NECROSIS.

**Necrosis** (from νεκροω, to kill) is a mortification of the bones that corresponds in its general character and results with mortification—not sphacelus—of the soft tissues, there being commonly sufficient vitality in the surrounding structures to separate the dead from the living portion. In mortification of the soft parts the dead portion, when of limited extent, was designated as a slough, this portion retaining enough of the elements of the dead structure to show that it had belonged to a soft tissue. In the bones the dead portion, if small, is designated as an "exfoliation;" if larger, as a "sequestrum," it also retaining enough of its original characteristics to show that it was once vital bony tissue; thus it will often preserve the original shape of the bone, its hardness, laminated character, and other peculiarities, though changed in color to a dead or tawny white, Fig. 323.



Fig. 323.

A lateral view of a Sequestrum from the inner surface of a long bone, showing its surfaces.

**Etiology.**—The causes of necrosis may be all placed under one head, to wit, such as impair the power of the circulation in the bone, and may be arranged as follows: 1. Separation, or division of the external periosteum. 2. The same lesions of the internal or medullary membrane. 3. Mortification as the result of inflammation of the bone itself or the injury of its nutritious artery. Through all these causes one general process may be noted, to wit, the death of one portion, and increased vascularity of adjacent parts, this increase being in proportion to the loss of vitality or size of the dead portion. This increased action amounts often to true healthy inflammation in both the internal and external periosteal membranes.

**Symptoms.**—In its commencement necrosis is usually preceded by sufficient inflammation to create a change either in the action of the external or internal periosteum, or both; hence the earliest symptoms are those of inflammation of the bone or its membranes, such as pain of a variable degree of intensity, which is often most marked during the night, with the other symptoms of periostitis. After the duration of these, for a longer or shorter period, a flattened uncircumscribed enlargement will be noted at the painful spot, without any change being perceptible in the color of the skin, until fluctuation is more or less evident, when the skin will redden, ulcerate, and give vent to pus through one or more orifices, the pus often bringing away some particles of the sloughing periosteum. These ulcerated points in the integuments over a necrosed bone are nearly always elevated, with a minute orifice in the centre, and hence are designated as *papillæ*. If the necrosis

is superficial, the bone will be readily felt denuded of its periosteum, the dead lamina will exfoliate and be thrown off by nature, healthy granulations and new bone will be formed, and over this the integuments will adhere and form a dense white but *depressed* cicatrix.

If the diseased bone involves the greater part of the thickness or length of a long bone, as the tibia or femur, all the symptoms will be more marked, the swelling embracing most of the circumference of the limb.    The ulcerations will also be numerous, the pus more thin, fetid, and ichorous, while a probe passed through the ulcerated integuments will enter a hypertrophied layer or shell of bone, and touch the denuded and necrosed portion within it.    At first this fragment or sequestrum will be more or less firmly adherent to the new bone thrown out around it, but in the latter stages of the complaint it becomes loose and movable, yielding to the force which touches it, and sometimes becoming so loose as to move readily with the motions of the patient.    The constitutional symptoms are those of irritative fever, this being due to the pain and discharge from the part, and the severity of the symptoms being in proportion to the extent of bone affected.    Throughout necrosis of a flat or part of a long bone the continuity of the bone is often unimpaired, and its functions are, therefore, more or less perfectly performed.

**State of the Tissues during Necrosis.**—It being admitted that necrosis is generally preceded by inflammatory action, and that this action leads to the destruction of one portion of the structure that is involved, it will be seen that the death of the bone or a portion of it is due to very much the same steps as the death of the soft parts when mortifying, the reparative effort in both instances being analogous, and due to healthy ulceration. Without recapitulating what has been said in connection with mortification of the soft parts, or repeating the allusion previously made to the action of the periosteum in the repair of fractures, we may now simply note the condition of parts around the necrosed portion, and the manner in which it is thrown off by nature.    From the extended observations of Stanley,* as well as from those of Paget,† it appears that the phenomena in necrosis which illustrate the process are—

1. A permanent and increased vascularity of the structures adjacent to the necrosed bone, this being indicated not only by the condition of its vessels but by the numerous enlarged Haversian canals.

2. A reparative process, due, as in mortification of the soft parts, to a limiting effusion and organization of lymph on the border of the living tissue, the latter, by interstitial deposit and absorption, forming "a line of demarkation," the groove around the dead bone being augmented until, as in mortification of the soft parts, it forms "a line of separation," the earthy matter being washed away in the pus, and not absorbed, as was thought by Hunter, while the animal matter retains its connection with the living bone, probably in consequence of its greater vitality.    Becquerel and Rodier‡ think that in necrosis there is a slight diminution in the gelatin and increase of the calcareous salts, the adipose matter remaining in the normal state.

The removal of portions of the earthy matter, when followed by the subsequent destruction of the animal and cancellated tissue, generally gives to the necrosed portion or the sequestrum a porous, spiculated, irregular surface and margin, as shown in Fig. 324.

3. The inner surface of the periosteum is usually the agent of these changes, its face becoming covered by granulations, which, as in the ordinary

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* On Diseases of the Bones.            † Lect. Surg. Pathol., p. 301. Phil. ed.
‡ Traité de Chimie Pathologique, p. 543, et supra.

growth of bone, create the nucleated cells from which new bone is formed. Hence, while one portion of the bone is being separated by degeneration, another is being formed by the reparative effort, the new material being thrown out around the old so as to incase it and preserve the continuity of the member.

Fig. 324.



4. The shell of new bone, Fig. 325, formed by the external periosteum around the necrosed portion is usually found perforated in numerous points, so as to give exit to the pus without materially weakening the part. These perforations are, it is thought, the result of the death of limited points of the external periosteum in consequence of which there is no nidus for the growth of new bone in those openings which originally ulcerated through the periosteum. When the loss of periosteum is extensive, an orifice termed "cloaca" is formed, through which the necrosed bone may sometimes be withdrawn from its shell.

5. One of the chief points of difference noted in the condition of parts in necrosis and in mortification of the soft tissues is found in the duration of the process, necrosis being slow and often requiring six, twelve, or eighteen months for its completion.

View of a Sequestrum as detached after an amputation of a femur, showing the character of its surface as well as its terminal connection with the living bone.

**Diagnosis.**—Necrosis, when once developed, may be readily recognized from caries by an examination with a probe, the necrosed bone being denuded, hard, rough, and often movable as a fragment, while caries is soft, porous, friable, and without distinct shape, seeming rather as a broken-down mass of tissue.

Fig. 325.

Fig. 326.





Fig. 325.—Necrosis of the Tibia, showing the perforations in the shell of new bone, as alluded to in the text.
Fig. 326.—Necrosis of the Tibia, showing a large cloaca with the sequestrum protruding.

**Prognosis.**—The prognosis of necrosis will vary with the position of the bone that is affected, but the disorder is seldom fatal to life; when the

necrosis is circumscribed and superficial, the sequestrum will be thrown off more quickly than when the disease is more extensive and deep seated. The prognosis, as regards the period of separation of the sequestrum, may be rendered more certain by examining the part carefully with a probe or director, in order to judge of its mobility and the amount of its attachments to adjacent parts. When free, and so situated as to be amenable to an operation, the prognosis as to the time of cure will be more favorable than it would be under different circumstances.

**Treatment.**—Little can be done for the relief of necrosis until nature has accomplished the separation of the dead from the living portion, except to regulate the inflammatory action. When the necrosis is the result of syphilitic periostitis, the constitutional remedies demanded in syphilis may prove useful, while in all cases the use of anodynes, with mild purgatives, will allay pain and diminish the irritative fever. If a wound has denuded the bone of its periosteum, replacing the integuments and favoring their adhesion will often serve as a prophylactic measure, while the warm water-dressing, rest, etc. will aid in diminishing the inflammation of the soft parts. When the necrosed bone is loosened by the process of nature, its removal, if it is of limited extent, may be accomplished by drawing it out with strong forceps, and treating the wound as a simple ulcer. But when the sequestrum is larger, and the dead bone is inclosed in a thick casing of new bone, the latter must be cut away sufficiently to permit the removal of the necrosed portion. The details of the process belong to operative surgery, but may here be generally stated as consisting in perforating the shell of new bone at two points with a trephine, and then chiseling out the intervening portion until an opening of sufficient size is obtained, the wound being subsequently made to heal by granulation, as will be described in connection with the operation of Resection, vol. ii.

# CHAPTER II.

## MODIFICATION OF NUTRITION IN THE BONES.

UNDER this head are usually placed Rickets, Mollities, and Fragilitas Ossium.

## SECTION I.

### RACHITIS, OR RICKETS.

The disorder here referred to as Rickets, is better known as Rachitis juvenilis, to distinguish it from R. adultorum and R. senilis.

Rickets, or a preternatural degree of flexibility in the bones, manifests itself as an affection of the skeleton of young children, in consequence of which the bones become curved and misshapen, so as to lead to the production of considerable deformity.

**Symptoms.**—Rickets generally makes its appearance first in the lower extremities, which become more or less curved, then extends to the pelvis, and finally involves the whole skeleton. Or it may only affect a single por-

tion of the skeleton, as the thorax, the remaining parts being healthy. According to Beylard,* the first appearance of any curvature is generally preceded by decided symptoms of digestive derangements, as enlarged abdomen, repugnance to food and exercise, with emaciation, and an abundant pale urine that deposits sediment of the phosphate of lime. These symptoms appear in early childhood, and not unfrequently in children at the breast, (though the disease is most frequent, according to Rokitansky,† in the second year of life,) and are followed by the appearance of enlargement of the joints and curvature of the bones.

Rickets interferes greatly with the growth of the skeleton, and especially with the growth of the long bones in length, and with the development of the pelvis and thorax—the thoracic deformity manifesting itself in the well-known pigeon-breasted condition, while the pelvic distortion renders more or less spinal curvature inevitable.

**Diagnosis.**—The diagnosis of rickets, unless the history is carefully studied, is often difficult at the commencement of the disorder. It is very liable to be mistaken for mollities ossium, and the diagnostic signs of each will be given under the latter subject.

**Prognosis.**—Rickets frequently terminates in recovery, which may be complete or associated with more or less brittleness of the bones, rendering fracture preternaturally easy. The same brittleness and liability to fracture is sometimes noted earlier in the progress of the affection. Any deformity which may exist at the time of convalescence is usually permanent, unless modified by surgical treatment. In the early stages of the disease, rickets is generally curable, provided the circumstances of the patient are such as to allow appropriate hygienic treatment to be resorted to. The deformities which result from it can often be relieved, if treatment is not too long postponed.

**Pathology.**—Rokitansky‡ describes two distinct textural modifications as occurring in rickets. In the first the bone is rarified and expanded, and its vascular canals and medullary areolæ are distended and filled with a pale yellowish-red jelly, the medullary spaces being sometimes more or less fused together into larger cavities, and the bones soft and fragile. In the second case, in addition to the above changes, there is noted more or less complete deficiency of the calcareous material of the bone, which now resembles closely a bone that has been steeped in acid; being exceedingly flexible, so as readily to permit curvatures to take place. According to Becquerel and Rodier,§ there is in rickets the following chemical changes to be noted:—

1. A considerable diminution of the phosphate of lime.
2. A proportional increase of gelatin.
3. An increase in the quantity of the fatty matter, which is often marked, though not so considerable as in osteo-malacia.

**Causes.**—The disposition to the production of rickets may be hereditary or acquired. Among the causes capable of developing the disorder in the children of healthy parents are neglect of hygienic conditions and improper alimentation—the disease being especially frequent among the children of the poor, and infants deprived of the breast and reared on artificial food.

**Treatment.**—The most important elements of the treatment are to be found in appropriate hygienic conditions, and especially pure air and nourishing easily digestible food, with cold bathing, or sponging of the surface with cold water, or salt and water. At the same time tonic remedies

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* Du Rachitis, etc., par E. J. Beylard. Paris, 1852.
† Loc. cit. p. 174, vol. iii.          ‡ Ibid. vol. iii. p. 175.
§ Traité de Chimie Pathol., p. 543, et supra.

may be resorted to, especially the preparations of iron, cod-liver oil, and quinine.*

Where deformity has already resulted, various mechanical contrivances may be advantageously employed, with the view of gradually bringing the bones into the normal position, but care should be taken not to use too weighty or cumbrous apparatus, or to employ too much force, the application of all forms of apparatus being carefully regulated, as will be again alluded to in connection with Club-foot.

## SECTION II.

### MOLLITIES OSSIUM.

SYNONYMS.—Osteo-malacia, malakosteon, rhachitismus adultorum, rhachitismus senilis.

Mollities ossium resembles rickets in some of its external characteristics, as it consists in a softening of the bone, which permits it to bend with the weight of the body, thus producing various curvatures and deformities. It differs from rickets, however, in many important particulars.

**Symptoms.**—Before any actual deformity renders the nature of the disease unmistakable, mollities ossium generally shows itself by symptoms similar in some respects to those of rheumatism, especially when the patient has been exposed to cold and moisture. At the beginning, according to Beylard,† there are vague deep-seated pains in various parts of the body, in the head, the chest, thighs, kidneys, and joints—pains which are often mistaken for rheumatism or gout, and which are frequently increased by movement and pressure. These pains, however, are not invariably present, the disease having been known to exist without them, or after a short duration they may subside, and the disorder, nevertheless, continue to progress. At the same time that the pains appear the patient finds that he becomes quickly fatigued, and soon cannot walk without assistance, sometimes, though not always, becoming bed-ridden. Emaciation now sets in, the skin is preternaturally warm, the pulse frequent, the digestion troubled, and constipation alternates with diarrhœa, the latter sometimes becoming colliquative. The urine is abundant, and generally deposits phosphate of lime, though sometimes it is albuminous. As these symptoms progress, various deformities arise in consequence of curvatures resulting from the preternatural flexibility of the bones. Articular enlargements also often occur, though these last are much less frequent after than before the twenty-fifth year.

According to Rokitansky,‡ the curvatures and deformities which result from mollities ossium are confined to the bones of the trunk, the extremities and cranium escaping; but, according to Beylard, though the cranium preserves its regular form, the bones become softened and altered in texture, and the limbs are affected similarly to the rest of the skeleton, and may be the seat of well-marked deformity. The deformities produced by this disease, however, show themselves especially in connection with the thorax, pelvis, and vertebral column. The vertebral deformity produces a diminution in the stature of the individual, which is well marked, so that he gradually becomes dwarfish in height as well as deformed, the spinal curvature being lateral, as a general rule, though sometimes it has an antero-posterior curv-

* On the Disorders of Infantile Development and Rickets, by A. S. Merei, M.D. London, 1855, p. 213.

† Loc. cit.                                             ‡ Loc. cit. vol. iii. p. 177.

ature also.  Not unfrequently in mollities, as in rickets, the bones break
with remarkable facility, a circumstance which would not have been expected
when it is remembered how readily they bend; and the brittleness resulting
from this cause, with that occurring in the bones of those who have been
rickety in youth, and from many other conditions, is included under the desig-
nation of Fragilitas Ossium.

**Nature of the Affection.**—Mollities ossium being a rare disease, and
opportunities for its study being by no means frequent, the term appears
to be used in different senses by several authors.   Thus, for example,
Paget and the English writers generally include under this designation those
cases which Rokitansky erects into the separate group of Osteo-porosis.*
In these cases the bones become preternaturally porous, the cancellated
tissue being especially enlarged, and filled with a pink or sanious liquid,
which is sometimes almost pulpy, the medullary canal being likewise much
enlarged and filled with this matter.   The periosteum is also thickened and
softened, and as if infiltrated with a somewhat similar pulpy matter.   These
bones are exceedingly brittle, and break with the slightest force.   They
furnish, according to Paget, whose views appear generally adopted by the
English pathologists, examples of fatty degeneration affecting the bones.

On the other hand, the mollities ossium of Rokitansky is a condition in
which the affected bones diminish in size, and are reduced to their carti-
laginous element, which, at the same time, is altered chemically, so that it
yields, in boiling, an animal matter quite unlike either chondrin or the animal
matter of healthy bone.   This disorder rarely, and only in a subordinate
manner, affects the cranium or extremities, being limited to the bones of
the trunk; and from the flexibility of the bony tissue, the most singular
deformities, especially of the thorax and pelvis, result; while the mollities
ossium of Paget is characterized rather by brittleness than by flexibility of
the bones, and affects the extremities in preference to the trunk.   On the
whole, then, we may conclude with Paget† that "there are two diseases
included under the name of mollities ossium—namely, the fatty degenera-
tion," "which seems to be more frequent in England; and the simpler
softening of bone, or rickets of the adult, to which Rokitansky's descrip-
tion alludes, and in which the bones are flexible rather than brittle, and
appear reduced to their cartilaginous state.   This affection appears to be
more frequent than the fatty degeneration in Germany and France."

Mollities ossium is most common in females, being sometimes seen at
puberty, but more frequently in adult life, or at the critical period.   It is,
however, a rare disorder.

**Causes.**—The causes are not well known; frequently the disorder has
been hereditary, though often the patient has suffered for a long time from
chronic diseases, which have weakened the powers of life, as the low forms
of fever, or uterine hemorrhages; but little is positively known in regard
to these points, the amount of our knowledge of the true causes creating
the condition being limited.

**Prognosis.**—The prognosis is decidedly unfavorable, nearly all the cases
recorded having died in a variable period of time from the subsequent de-
generation of other organs, especially the lungs, the function of the latter
being sometimes impaired by the changes created in the cavity of the
chest.

**Treatment.**—Little can be done to arrest the progress of the disorder,

* Paget's Lectures on Surgical Pathology.  Philadelphia edition, p. 98.  Rokitansky,
loc. cit. vol. iii. p. 171.
† Loc. cit. p. 99.

the indications being to add to the powers of life by the administration of tonics and chalybeates.    Phosphate of lime has been employed, but little benefit has been noticed from its use.

## SECTION III.

### FRAGILITAS OSSIUM.

Under the designation of **Fragilitas Ossium,** or **Brittle Bones,** many writers have described a condition of the bones supposed to result from an excess of the calcareous salts—a condition directly opposite to that observed in rickets and osteo-malacia. There can be no doubt, however, that a large number of the so-called cases of fragilitas ossium are dependent upon both rickets and osteo-malacia.    Beylard, indeed, recognizes no fragilitas ossium other than that arising from them.  Stanley* says that it is doubtful whether mollities and fragilitas are distinct diseases.   Rokitansky does not mention fragilitas ossium as a separate affection ; and Paget,† while describing mollities as often producing undue brittleness of the bones, and hinting the probability of calcareous degeneration (excess of calcareous salts) in these cases, admits that this probability is not strengthened by actual analyses, which, as yet, have only shown excess of earthy matter in the bones of old age.  Nevertheless, extreme brittleness of the bones having been observed in cancerous patients, as mentioned by Dupuytren, and in some other conditions apparently distinct from mollities and rickets, as in senile atrophy, the term fragilitas ossium may be conveniently retained to indicate the unnatural brittleness, let it arise from what causes it may.

Fragilitas ossium predisposes the patient to fracture from the most trifling causes, and is generally the result of some congenital peculiarity which is not accurately known.    The number of fractures in the same patient under this peculiarity of constitution is sometimes wonderful, one case having been reported of a woman, who had twenty-three fractures in the course of two years and a half.   One of a lady, who has suffered about eight fractures in as many years, is well known to me ; and within three years I have had occasion to treat her for fracture of the humerus, of the radius, and of the femur, all inducted by trifling forces, she having been previously treated for others in the same limbs.

**Treatment.**—The treatment of the fractures found in these patients is usually the same as that required by fractures arising in those of sound constitutions, though, as far as personal observation has gone, it has seemed to me that the union was much more rapid and perfect than under ordinary circumstances.    In the case of the lady alluded to, about one-third less time was demanded than that usually employed in the cure.    The constitutional treatment should consist in the administration of chalybeates and tonics, aided by the cold bath and general hygienic measures to improve the patient's strength and powers of digestion.

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* Stanley on the Bones.    Phila. edit. p. 190.          † Paget, loc. cit. p. 96.

# CHAPTER III.

## BONY GROWTHS, OR TUMORS.

THE morbid growths which occur in connection with the bones, although essentially similar to those described in connection with the soft parts, present, nevertheless, certain peculiarities of appearance and history, and require such modifications of treatment, as render it proper to discuss them under separate heads. The following varieties, under which almost all of the bony tumors, as arranged by Rokitansky and Paget, may be classified, will here be briefly alluded to :—

1. **Fibrous Tumors** of Bone.
2. **Fibro-plastic**, or **Myeloid** Tumors of Bone.
3. **Cysts** in Bones, or **Cystic** Tumors of Bone.
4. **Vascular**, or Pulsating Tumors of Bone.
5. **Enchondromata**, or Cartilaginous Tumors of Bone.
6. **Exostoses**, or Bony Tumors of Bone.
7. **Cancerous** Tumors of the Bones.

## SECTION I.

### FIBROUS AND FIBRO-PLASTIC TUMORS OF BONE.

Either of these abnormal growths may occur in the bones, though neither of them is frequent. They generally occur in connection with the medullary membrane, and, distending the bone, are coated by the compact tissue as a thin bony shell, which may be perfect or give way, and permit the tumor to protrude through it.

#### § 1.—Fibrous Tumors of Bone.

**Fibrous Tumors of Bone** are most frequently found, according to Paget,* in or about the jaws. They are rounded or oval, generally knobbed or superficially lobed, firm, dense, and heavy. In some cases they grow *within* the jaw-bones, expanding the walls of the affected bone to a thin covering, from which they may be enucleated. But in very many instances their starting-point is in connection with the periosteum, from which they encroach inward upon the bone tissue, as well as outward upon surrounding parts.

#### § 2.—Fibro-plastic or Myeloid Tumors of Bone.

**Fibro-plastic Tumors of Bone** have been well described by Paget under the name of **Myeloid** tumors,† and include many of the growths formerly

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* Surg. Path. Phila. ed. p. 407.      † Ibid. p. 446.

( 699 )

termed **Osteo-Sarcoma**, under which head were also embraced, by the older writers, enchondromata and very many of the cancers of bone. The myeloid tumors of Paget may either be located in the interior of the bone, with its walls expanded as a bony shell over them, or may originate in connection with the periosteum, and thence encroach upon the cancellated tissue within. They may either be firm and fleshy in consistence, or soft and pulpy.

The cut surface is smooth, shining, and grayish, or greenish white, often mottled with brownish, pinkish, or crimson spots. Sometimes spiculæ, or irregular masses of bone, or cysts of various sizes, are found imbedded in the tissue of the tumor.

**Microscopical Appearances.**—Besides the nuclei and spindle-shaped cells characteristic of the fibro-plastic tumors, as described in connection with the history of these growths, large, rounded cells, or cell-like masses $\frac{1}{300}$ to $\frac{1}{1000}$ of an inch in diameter, and containing from two to ten or more oval, clear, nucleolated nuclei, are to be met with.

These multinuclear cells are similar to certain multinucleated cells observable in fœtal marrow, and hence the name myeloid—μυελωδης, marrow-like—proposed by Paget.

**History.**—According to Paget, myeloid tumors usually occur singly, before middle age, grow slowly, and without pain, and have no proneness to ulceration. They are also stated to be inapt to return after removal, though occasionally they do so, and may even involve internal organs, and behave in other respects like cancerous affections.


## SECTION II.

### CYSTOMA IN THE BONES.

**Serous Cysts**—that is, cysts filled with a serum-like liquid—are occasionally found in bones, being most frequent, according to Rokitansky,* in the lower jaw, and next in the upper jaw, though any bone may be the seat of these formations. These cysts may acquire the size of a hen's egg, or even a greater bulk. By their pressure, when they originate in the interior of a bone, the osseous tissue is expanded, and finally becomes very thin, crackling under pressure like parchment. Or, finally, the bone may give way and the cyst protrude.

Besides the above, acephalocysts, with or without contained enchinococci, have been met with in the bones, in which they have occasionally formed tumors of sufficient size to have been made the objects of surgical interference.


## SECTION III.

### ANGIONOMA OR OSTEO-ANEURISM—PULSATING TUMORS IN BONE—ANEURISM BY ANASTOMOSIS—TELEANGIECTASIS IN BONE, ETC.

A condition of the blood-vessels in bone sometimes occurs which is quite similar to that seen in the skin in nævus, and is called **Osteo-Aneurism.** According to Rokitansky,† it seldom originates as a primary disease, but most generally in connection with cancer, the carcinomatous texture affording the matrix in which the enlarged and convoluted vessels luxuriate. Sometimes the blood-vessel rupture, and the extravasated blood accumulates in coagulated layers in the interstices of the tissue.

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* Vol. iii. p. 184. Sydenham edit.          † Vol. iii. p. 183.

The tumors thus produced are rounded, moderately soft, and sometimes pulsate. Their size is variable, considerable bulk being occasionally attained. The new formation originates in the interior of the bone, and is at first completely inclosed by it. As it increases in size, the bone, at first distended, so as to form a bony shell for the growth, finally gives way, and suffers it to protrude at the most prominent point.

A tumor of this character was removed by me in the winter of 1858, and the preparation is now in my cabinet; it occupied the lower extremity of the tibia, and encroached somewhat upon the fibula.

The tumor was about the size of a man's fist, and presented a decided pulsation similar to that of an aneurism. The muscles and soft parts were pushed aside as the growth developed, but were not involved in the disease. The anterior and posterior tibial arteries passed by the growth without being involved, but the anterior interosseous artery, very much enlarged, plunged into the superior part of the growth, and was lost in its substance. The compact layer of the tibia, thinned and distended, formed a partial capsule for this tumor, which, however, had projected through the bony covering, so that a very large part of it was merely surrounded by a thin sac of connective tissue. The tumor was composed almost entirely of enlarged and very tortuous blood-vessels, between which was a small amount of a yellowish-white pulp, presenting the anatomy of soft cancer.

The limb was removed by amputation just below the knee. The patient recovered from the effects of the operation, and was in good health when seen eighteen months subsequently.

**Diagnosis.**—The pulsating tumors of bone might be confounded with aneurisms, which they resemble in their pulsations, which cease when the main artery of the limb is compressed, and also frequently in the presence of a bruit, or bellows sound. The seat of the tumor, however, will very frequently enable a diagnosis to be made. Bony tumors of the most various kinds may have a pulsation communicated to them from some large subjacent artery, and may then be distinguished with the utmost difficulty from the class under consideration.

It is of great practical importance to distinguish those cases in which this aneurismal condition occurs primarily, from those in which it has resulted secondarily from a cancerous formation. According to Erichsen,* the true osteo-aneurism is single, and occurs only in the articular extremities of bone; whereas the carcinomatous affection may exist in any portion of the bone, and is frequently found in different bones at the same time.

**Treatment.**—If the case be one of osteo-aneurism, without any cancerous formation, a ligature may be applied to the main artery of the limb. A number of successful cases have been recorded. Excision of the part has been resorted to, but without satisfactory results. If the disease be malignant, amputation must be performed.

## SECTION IV.

### ENCHONDROMATA—CARTILAGINOUS TUMORS.

**Enchondromata,** or **Cartilaginous Tumors,** are more frequent in bone than in any of the other tissues of the body, all the details of the history and anatomy of these growths, which have been presented in a former chapter, being equally applicable to their development in the bony tissue.

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* The Science and Art of Surgery, by John Erichsen. Phila. ed. p. 605.

Enchondromata are stated by Rokitansky* to occur most frequently in the bones of the fingers and toes, but they are also found in the ribs, sternum, bones of the skull, ilium, and the long bones, as the humerus and femur. Like the fibrous, fibro-plastic, and other tumors of bone, they may originate in the interior of the bone, distending it, and being coated by it, or they may commence externally in connection with the periosteum, and thence encroach upon the bone.

Enchondromata generally appear early in life, and grow slowly.    They may remain cartilaginous during life, or may ossify to a variable extent. The question of their innocence or malignancy has been already discussed.

Enchondromata were included by the older writers in their group of **Osteo-sarcoma.**

## SECTION V.

### EXOSTOSIS.

By an Exostosis—εξ, out of, and οστεον, a bone—is meant a bony growth or tumor " set upon a bone," which is due to a true hypertrophy, and which may arise either from the compact or cancellated tissue of the bone.

**Varieties.**—Various kinds of exostoses are met with, that which is formed mainly of the compact tissue being hard and solid, its texture being homologous with that of its point of origin, and known as the *"eburnated"* or ivory-like ; that which is formed of superimposed layers, as the *laminated;* while that formed chiefly of cancellated tissue is designated as *"spongy."* The compact ivory-like or hard exostoses are the most common.  Exostoses are also named from their shape, as the *circumscribed, tuberculated,* and *spinous.*    A circumscribed exostosis is a mere projection from the bone of a limited extent ; the tuberculated or knotted is an irregular knob or excrescence ; while the spinous resembles in shape the thorn of the rose-bush, or some similar blunt-pointed growth, all being more or less solid in their structure.    When the growth enters a cavity, as the cranium or pelvis, Rokitansky proposes to designate it as **Enostosis.**

**Seat and Result.**—Exostoses vary much in their size and position, all the bones being liable to them, but especially those which are superficial, as the cranium, clavicle, tibia, lower jaw, sternum, and ribs.    The tuberculated and laminated varieties are chiefly found in the flat bones, as those of the head ; while the spinous and circumscribed are seen in connection with the long bones.    Exostoses are followed by results which vary in accordance with their position ; thus an enostosis from the interior of the cranium would be liable to compress the brain, and an exostosis on the long bones of the extremities would create inconvenience by interfering with the play of tendons and muscles, or acting on the coats of the blood-vessels, or irritating the nerves.

**Pathological Changes.**—In all exostoses the periosteum is liable to be more or less changed, the development of the growth being generally due to the action of this tissue either directly or indirectly.    Generally, the periosteum is thickened, injected, or sometimes softened around the exostosis, especially in the tuberculated and spinous varieties, while in the spongy it may be unchanged, the chief action being at the expense of the cancellated structure, which expands the compact layer without creating any marked change in the periosteum over it.  The soft parts around an exostosis are often but slightly affected by it, if it is small, while, when it is large, they may be so

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* Manual of Path. Anat., vol. iii. p. 185.  Syd. edit.

distended as to be very much thinned, the muscles sometimes disappearing to such an extent as to leave only a thin layer of muscular fibres over the tumor. The color of an exostosis is usually that of healthy bone.

**Causes.**—Exostoses may be produced by any cause which will induce increased action in the bone or its investing membrane, and often follow the development of tubercles in the bone, or secondary or tertiary syphilis, or rheumatism and gout. In the tibia they sometimes supervene on the long-continued irritation of ulcers or nodes, or from repeated contusions of the skin.

**Symptoms.**—The development of exostoses is characterized by various symptoms, especially in their commencement by those which have been detailed as due to periostitis or ostitis. The symptoms, after the growth attains a certain size, are those due to the compression of adjacent parts— as swelling, redness, lividity, heat, and inflammation, with ulceration of the skin; abscesses of the areolar tissue; neuralgia, from irritation of the nerves; and aneurisms or obliteration of the arterial channels. When seated near joints, exostoses may impair the motion of the articulation, or develop synovitis, with effusions within the joint, and subsequent anchylosis. When seated on the vertebræ, they often impair the flexion and extension of the spinal column. When an enostosis is liable to press on the brain or spinal canal, it is also apt to be followed by general or local paralysis; while in the pelvis it may interfere with the birth of the fœtus, or with the functions of the bladder and pelvic viscera.

**Diagnosis.**—The diagnosis of exostoses may be readily made if superficial, by the sense of touch, as they present the characters of firm and hard tumors, of a shape which varies in accordance with the variety.

**Prognosis.**—The prognosis of an exostosis is generally very slow and tedious. It may disappear, or, after having reached a certain point, cease to grow, and ultimately become somewhat diminished, though it seldom disappears entirely. The result to life, or the usefulness of adjacent structures, will depend upon its position, as it is dangerous in accordance with the importance of the parts pressed on by its growth.

**Treatment.**—The treatment of an exostosis should consist both in local and constitutional measures, the internal remedies being addressed to the supposed cause of the disorder, and being such as are appropriate to the constitutional treatment of syphilis, rheumatism, or the tuberculous diathesis. As a general rule, the administration of mercurials is useful as an alterative, while diaphoretics and purgatives are often demanded, with the free use of anodynes if neuralgic symptoms are developed.

The local treatment may consist in the employment of blisters in the neighborhood of the exostosis; in incisions on the tumor when it is superficial, the periosteum being divided around the base of the growth, so as to create a limited necrosis; or in a resection of the substance of the bone, or of a portion of the exostosis when it interferes with the play of the tendons. After the removal of an exostosis by an operation, the wound should, if possible, be made to unite by the first intention, in order to prevent exfoliation of the adjacent bony tissue.

## SECTION VI.

### CANCER OF THE BONES.

**Scirrhus, Medullary,** and **Melanotic Cancers** may occur in connection with the bones. They may originate in the bone structure, or extend to

it from neighboring tissues. In the former case, according to Roki-tansky,* they almost always originate "in the diploë, in cancellated bones or parts of bones, or in the medullary cavities." Bone cancer, or several of them, may be the only morbid products in any given case, or they may coexist with the manifestations of the disease elsewhere.

**Scirrhus Cancer of the Bones** is most frequently developed in the medullary canal of the long bones, distending the surrounding osseous tissue till it forms a mere bony shell for the tumor, under which condition *fractures* may occur with preternatural facility.

**Medullary Cancer** in a comparatively short time produces masses which are sometimes of a truly gigantic size. These, distending the bone, may be coated with it as a bony shell, from which rapidly developing texture may escape at one or more places, and produce projecting fungous masses, which present the ordinary characteristics of soft cancer originating elsewhere.

The cancerous mass frequently, but not always, presents a more or less irregular bony skeleton or framework, the meshes or areolæ of which are filled with cancer tissue; these growths constituted by far the majority of those included by the older surgeons under the designation of Osteo-Sarcoma.

**Diagnosis.**—Although of the greatest importance, it is often difficult in the earlier stages to distinguish malignant from non-malignant tumors. The cancerous deposit is most generally found early in life; at first it is deep seated, but grows rapidly, and often, with much lancinating pain, approaches the surface. The size attained is sometimes very great; the surface is frequently lobulated, the subcutaneous veins become very tortuous and distended, and, as the disease extends, the neighboring lymphatic glands become enlarged and hardened.

**Treatment.**—As in cancer elsewhere, very little can be done except by removal of the diseased part; and as the cancer is more liable to return than when removed from the soft tissues, it is advisable to operate even less frequently. The cancer may be removed by excision or amputation. In the face and trunk, resection is of course the only choice. In the extremities, amputation is preferable to resection, as the disease is less apt to return. The amputation should for the same reason be performed as near the trunk as possible.

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## AMERICAN PAPERS RELATING TO DISEASES OF THE BONES.

For numerous surgical papers on these disorders, and the operations resorted to for their relief, see Resection, vol. ii.

Circumscribed Abscess in Bone, by P. C. Bleek, M.D. Kings Co., New York.— *New York Journal of Medicine*, vol. xiv. N. S. p. 83.                        1855.

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Chronic Sinuous Abscess of Bone, by T. M. Markoe, M.D. New York.—*New York Journal of Medicine*, vol. iv. 3d Series, p. 305.                        1858.

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* Loc. cit. p. 195.

# PART VIII.

## LUXATIONS OR DISLOCATIONS.

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### CHAPTER I.

#### LUXATIONS OR DISLOCATIONS.

When the natural relations existing between two articulating surfaces of bones are changed by the displacement of either, the displaced bone is said to be **luxated** or **dislocated**, (*luxare*, to put out of place, *disloco*, to displace.)

**Varieties.**—For the purposes of methodical study, **Luxations** have been variously classified, either according to the *position* taken by the displaced bone, or according to the nature of the injury to the surrounding parts. According to the *position* of the displaced bone, luxations are described as *primitive* and *consecutive, complete* and *partial;* and according to the amount of injury inflicted on the adjacent tissues, they are designated as *simple, compound*, and *complicated*.

1. A **Primitive Luxation** is one in which the articulating surface of a bone is driven out of its natural articulating cavity, to occupy some new and false position.

2. A **Consecutive Luxation** is one in which the head of a bone leaves its new and abnormal position for some other unnatural one.

3. A **Complete Luxation** is one in which the articulating surface of a bone is driven entirely from its natural articulating surface.

4. An **Incomplete Luxation**, or a **Subluxation**, is one in which the bone is displaced from the articulation, but not entirely so, some portion of its articulating surface still remaining in the natural cavity or upon its edge. Under this variety would come a luxation of the humerus, where the head of the bone rested upon the edge of the glenoid cavity.

5. A **Simple Luxation** is one in which there is merely a displacement, without any greater injury to the surrounding parts than is necessary to permit such an accident, the injury being accompanied by no external wound.

6. A **Compound Luxation** is one in which there is a wound, communicating with the articulating surfaces of the displaced bones.

7. A **Complicated Luxation** is one in which the patient suffers simultaneously from any other injury; thus, a dislocation may be complicated with fracture, or with aneurism, etc.

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**Etiology.**—The causes of luxation may be classified as *predisposing* and *exciting*, or as constitutional and local.

Among the predisposing or constitutional causes, may be enumerated diseases of the articulating surfaces of the bones, relaxation of the ligaments, and paralysis of the muscles. The exciting causes are mechanical violence, or muscular contractions of such a character as to force the bone from its position. Luxations are produced in various joints with different degrees of facility, the ball-and-socket joints being more liable to the accident than the ginglymoid. The nature of the joint, also, affects the direction of the luxation. In a ball-and-socket joint, luxations may generally occur in four directions—upward, downward, forward, and backward. In the ginglymoid joints, on the other hand, they occur most frequently laterally, though sometimes also backward or forward, as in the case of the knee, ankle, or elbow joints.

**Pathology.**—A *post-mortem* examination, in a case of recent luxation, reveals more or less effusion of blood, and laceration of the tissues surrounding the displaced bone, as the capsular ligament and muscles. Lacerations of blood-vessels, and contusion or stretching of nerves of considerable size, are also sometimes found. If the luxation has remained *unreduced* for a considerable period, other changes appear, which are due to the progress of inflammation; thus it will be found that lymph has been created and organized so as to form various adhesions, which now bind together the parts surrounding the joint, large nerves or vessels being in this way caused to adhere closely to the displaced bone, as is sometimes the case with those of the axilla in old luxations of the shoulder-joint. When efforts at reduction are made under these circumstances, the artery is apt to be torn, and aneurism or death to ensue. If the head of the displaced bone has been in contact with a bony surface for any length of time, in its new position, it will also sometimes be seen that the fibrinous deposits in this locality have resulted in the formation of callus, thus producing a new articulating cavity, more or less complete, many specimens of which are to be found in our cabinets. Such new articulations often possess a considerable degree of mobility. In the formation of these new articular cavities the pressure of the displaced bone usually first induces absorption of the muscles, etc., and then such increased action of the periosteum of the bone pressed on as leads to a new bony deposit around the luxated bone and the formation of a new articulation that often forms a good substitute for the normal one.

**Symptoms.**—The symptoms of luxations are often well marked. There is *pain* caused by the stretching and laceration of nerves, or by pressure upon them, in consequence of the new position of the displaced bone. There is *change in the appearance* of the joint, the natural shape, rotundity, and fullness having been modified, while deformities result that will be fully described in connection with special luxations. There is also usually *impaired mobility* in the bones luxated, and changes in the condition of the surrounding muscles, some being put preternaturally upon the stretch, and some preternaturally relaxed; while there is often a marked change in the length of the luxated bone as compared with its usual position. Moist crepitus is also sometimes noted.

**Diagnosis.**—The diagnosis of luxation requires great care and a good anatomical knowledge of the parts concerned, luxations being liable to be confounded with sprains, fractures, lacerations of the ligaments of the injured articulation, chronic diseases of the joints, as hip-joint disease or white swelling, and displacement of the articular cartilage. The diagnosis from these diseases and injuries will be given in connection with special luxations.

**Prognosis.**—The prognosis of a luxation varies greatly. If *simple*, the prognosis is usually favorable; but if *complicated* or *compound*, it should

be guarded, compound luxations being often followed by violent arthritis, and such constitutional and local disturbance as may result in the loss of a limb, or loss of life—extended suppuration and hectic fever occasionally ensuing. Luxations of the ginglymoid joints are usually more difficult to reduce than those of the ball-and-socket articulations, while the size of the articulation, and especially the character of the muscles surrounding it, will materially influence the result. A chronic luxation, when only of two weeks' standing, is less certain of reduction than an acute or recent displacement, and in some luxations certain limits are assigned, beyond which it is deemed unadvisable to attempt the reduction, as will be hereafter shown. The amount of adhesion supervening on the displacement of a bone, and the probability of the more or less perfect obliteration by inflammatory action of its former articulating cavity, will also materially influence the prognosis.

Treatment.—The indications to be fulfilled in the treatment of luxations generally are four : 1. To replace the luxated bone as soon as possible.  2. To prevent its renewed displacement.  3. To combat the inflammation of the joint and adjacent tissues likely to supervene on the injury.  4. To prevent anchylosis and re-establish the function of the joint.

1. In replacing a luxated bone such manipulation is demanded as will overcome the obstacles offered to its return to its articular cavity, these manipulations being designated technically as *reduction*. As the chief obstacle to the reduction of *recent* luxations is found in the action of such muscles as are put upon the stretch by the displaced bone, in the irregular laceration of the capsular ligament which binds the luxated bone on· its new position in many instances, as well as in the irregular bony surfaces composing the surface or margin of an articulation, such means must be resorted to as will facilitate the removal of these obstacles. Formerly the contracted muscles were stretched by a force greater than that which they could resist, this force being designated as *extension*, and that which prevent the body yielding to it being known as *counter-extension*. But since the introduction of anæsthetics, and the development of anatomical and physiological observations, such brute force has yielded to more scientific and gentle manipulation ; *rotation* and *circumduction*, with anæsthesia, or even without it, accomplishing what pulleys and the efforts of strong men formerly often failed to do, as will be shown in connection with the treatment of special cases. Few luxations are now met with that cannot be well treated simply by such manipulation as will change the relations of the parts and free the luxated bone from surrounding bony prominences, as well as spasmodic muscular action, while enabling it to re-enter the capsule through the opening by which it escaped. In few points of practical surgery has greater progress been made in the last ten years than in the reduction of luxations, manipulation with the bone in such a position as it took when being luxated sufficing entirely for the reduction.

2. The creation of a luxation having induced more or less laceration of the capsular and other ligaments, with a loss of power in the muscles that mainly strengthen the articulations, such means are required for fulfilling the second indication as will keep the joint at rest until the lacerated ligaments have healed and the muscles recovered their normal tone. As these means must vary with each joint luxated, the details will be hereafter given.

3. The combating of the inflammation of a joint liable to ensue on a luxation is to be accomplished by perfect rest, the local abstraction of blood by cups or leeches, the use of cold washes, and all such measures as have been already alluded to under the head of acute arthritis.

4. The prevention of false anchylosis and the re-establishment of the normal functions of the joint may be accomplished by passive motion at as

early a period as possible after the union of the lacerated capsule, that is, as soon as motion can be made in the joint without causing acute suffering. By gentle daily motion, so as not to strain the recently healed ligaments; by friction with cold water or camphorated liniment; by the application of one pole of the electro-magnetic battery around the joint, while the other is placed on the course of the main nervous trunk that supplies it, much may be done to expedite the cure. The time requisite for the restoration of the functions of a luxated joint, after its reduction, will vary from two to eight or ten weeks—in accordance with the extent of the injury, and the size and character of the joint. In some cases irregular nervous action and paralysis of the limb supervene upon a luxation, especially when the large trunks of nerves have been pressed on by the displaced bone. In these cases the cold douche and the electro-magnetic current, daily applied on the course of the nerve and to the affected muscles, will often accomplish a good purpose. Electricity is especially useful in the relief of this condition, as it stimulates the local circulation and prevents atrophy of the paralyzed muscles, and at the same time exercises a most beneficial influence on the nerve affected. Should there be reason to think that the neurilemma is thickened—as is sometimes shown by tumefaction at a point, extreme sensibility, etc.—blisters, gentle friction, and anodynes will often be highly useful by favoring the removal of the induration.

In **subluxations** due to a preternatural relaxation of the articulating ligaments, local stimulants, as blisters and electricity, are also frequently useful by inducing increased vascular action, and a corresponding increase of nutrition and development.

# CHAPTER II.

## LUXATIONS OF THE BONES OF THE HEAD AND TRUNK.

### SECTION I.

#### LUXATION OF THE INFERIOR MAXILLARY BONE.

**Luxation of the Lower Jaw** may be produced by causes similar to those that created fracture of this bone; but the former, as has been previously stated, is much more common than the latter accident, on account of the mobility of the jaw.

**Anatomical Relations.**—The articulation of the lower jaw is formed by the condyloid process of the inferior maxillary bone, which articulates with the glenoid cavity of the temporal bone. It is surrounded by a capsular ligament, and has within its cavity a structure known as the interarticular cartilage, which equalizes the two surfaces in the various positions which the bone assumes. The joint presents also an external and internal lateral ligament, and two synovial membranes.

**Etiology.**—When a violent force is applied to the front of the jaw, while the mouth is open, it may produce luxation of the inferior maxilla, by driving it back until the mastoid process of the temporal bone becomes a fulcrum, while the force applied to the chin acts on the bone as a lever, whence the condyloid process is thrown forward, and brought to bear against the ante-

rior surface of the capsular ligament. This giving way, the condyle slips out so as to take a position in advance of the glenoid cavity. Luxation of the lower jaw may affect either the articulation of one side or both; the former is designated as a *partial* or lateral luxation, and the latter as a *complete* luxation. Either occurs most frequently in persons of middle age, though sometimes seen in early life and in old age. There is also a condition of parts, which permits the production of what is described as a spontaneous luxation of the lower jaw, this being due to a relaxation of the muscles and ligaments of the parts permitting the luxation to occur at pleasure, or from trifling causes. Patients are thus sometimes found in whom the simple act of yawning is sufficient to induce the luxation. Fortunately, however, the same relaxation which permits the ready occurrence of the luxation renders it also very easy of reduction.

**Symptoms.**—The symptoms of luxation of the lower jaw vary: if it be of one side only, (partial luxation,) the jaw will be twisted toward the opposite side, the chin slightly protruded, and the mouth held permanently more or less open; if it affects both sides, (complete luxation,) the mouth will be held forcibly wide open, the chin will be thrust forward, speech and deglutition rendered impossible, the saliva dribble from the mouth, and the appearance of the patient be so characteristic that the accident will be readily recognized, Fig. 327.

Fig. 327.



When such a condition occurs, the temporal as well as the masseter and pterygoid muscles are put upon the stretch, and often spasmodically contracted, while the muscles on the front of the neck inserted into the hyoid bone and the jaw, are relaxed.

**Diagnosis.**—The marked character of the deformity, and the absence of crepitus, usually render the diagnosis of this accident quite easy.

**Prognosis.**—If the accident is of recent occurrence, the prognosis is favorable.

Fig. 328.

**Treatment.**—In the treatment of a perfect luxation of the jaw, it is usually necessary to exert such a force as will overcome the contraction of the extended muscles, particularly the temporal and masseter, and draw down the jaw, so as to enable its condyloid process to clear the prominence of the anterior edge of the glenoid cavity, until it can be slipped back into its true position. The patient should, therefore, be placed upon a low seat, and his head steadied by an assistant, while the thumbs



of the operator, unless he be willing to rely upon his dexterity in slipping
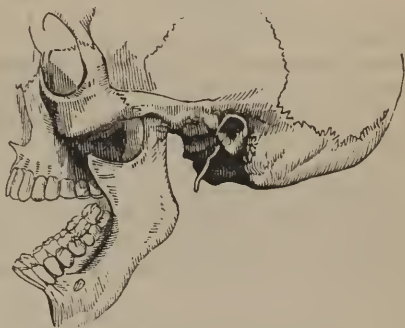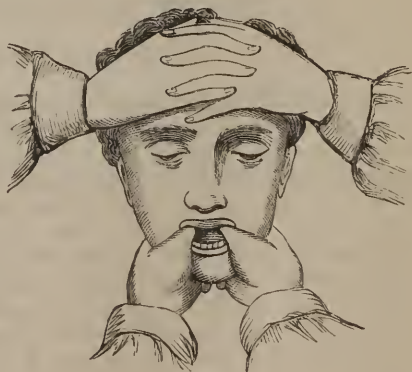
them out of the way, should be wrapped in a handkerchief or towel, and introduced into the mouth, so as to bear upon the molars of the inferior maxillary bone. When thus placed, the surgeon should depress the back part of the jaw by the thumbs, while the chin should be elevated by the fingers of the same hand, until the contracted muscles begin to yield, when the bone will suddenly slip backward into its place, and create an audible snap, Fig. 328. Generally, when the surgeon feels the jaw begin to yield to his forces, he should slip his thumbs off the teeth out into the cheek, to avoid having them bruised by the spasmodic closure of the jaw which ensues. When the luxation is reduced, the jaw should be bound up with a handkerchief to keep it at rest; but for some weeks after the bandage is dispensed with, the patient should refrain from biting upon hard substances, or opening his mouth widely, lest he reproduce the luxation. Should arthritis supervene, it must be counteracted by the treatment before mentioned, and false anchylosis prevented by cautious motion of the articulation. In the treatment of the lateral luxation, similar manipulation on the affected side will be demanded.

### § 1.—Subluxation of the Inferior Maxillary Bone.

**Symptoms.**—Cases sometimes occur in which the patient complains that, whenever he moves the lower jaw, he hears a peculiar crackling noise in the articulation, which causes him pain, a condition that is usually described by writers as subluxation of the inferior maxillary bone.

**Pathology.**—The true condition of parts in this affection is generally more or less deficiency in the synovial secretion of the joint, together with such a relaxation of the ligaments as enables the interarticular cartilage to slide forward and be pinched between the bones.

**Diagnosis.**—The diagnosis is easy.

**Prognosis.**—The case is one rather of annoyance than of danger to the patient.

**Treatment.**—The most effectual plan of treatment is the use of means calculated to give tone to the parts; shower-baths and cold douches proving highly serviceable; but, perhaps, the most successful treatment is the repeated application of small blisters in the neighborhood of the articulation.

## SECTION II.

### LUXATIONS OF THE BONES OF THE TRUNK.

### § 1.—Luxations of the Vertebrae.

Luxations may occur in any part of the spinal column; but the injury is not a common one. Generally, it is the result of a force applied to one portion of the spine while the rest is fixed, and requires a considerable amount of mechanical power for its development, being seldom produced by muscular contraction, except when aided by weights on the head. The part of the spinal column most likely to suffer is the cervical portion, (see Fig. 329,) especially the articulation between the atlas and dentata. When the latter luxation takes place, sudden death commonly results from pressure upon the spinal cord, which, indeed, is by no means an uncommon termination in luxations of any of the cervical vertebræ above the fourth.

In luxations of the cervical, (see Figs. 329 and 330,) dorsal, or lumbar vertebræ, if the luxation is complete, pressure upon the spinal cord at the

seat of the injury, and more or less paralysis of the parts supplied by nerves
given off below the seat of compression, will generally ensue, this being fol-
lowed by death if the pressure is long continued.



Fig. 329.

Fig. 330.

Fig. 329.—A FRONT VIEW OF A LUXATION OF THE SPINE BETWEEN THE FOURTH AND FIFTH CERVICAL VERTEBRÆ,
the patient having fallen backward over a high paling and alighted on his head.  The spinal cord was torn,
and there was complete paralysis, followed by death in a few days.
Fig. 330.—A side view of the same, the spinal canal being laid open, in order to show the compression and
laceration of the spinal cord.

**Symptoms.**—The symptoms in those cases which have not at once term-
inated fatally, have generally been those of compression of the spinal cord
from other causes, and hence we have paralysis of the extremities, etc.
Besides which, a careful examination of the vertebral column sometimes re-
veals the displacement of one or more of the spinous processes at the seat of
the injury.

**Diagnosis.**—The permanency of the deformity, the immobility and twisted
direction of the column, with the sudden paralysis, generally suffice to diag-
nosticate this injury, and distinguish it from a fracture.

**Prognosis.**—The prognosis is always grave, the patient rarely recovering
completely from the effects even of a partial luxation if the spinal marrow
has been compressed.  With regard to the probability of a fatal issue, it
may be stated, as a general rule, that the higher the seat of the injury in
the spine, the greater will be the danger to life.

**Treatment.**—The treatment of any luxation of the vertebræ requires great
care.  If the injury has not immediately terminated in death, it is some-
times possible, by moderate extension and counter-extension, to reduce the
luxation, and this is especially the case in those instances in which the acci-
dent occurs to children from injudicious manœuvres on the part of parents
or friends, such as lifting a child up by its ears to make it "see London;"
when, as it struggles violently to free itself, a dislocation is produced, chil-
dren having been known to drop dead under these circumstances.  In such a
case, if life is not extinct, it will be justifiable to make a moderate amount
of extension by promptly drawing on the head with the hands, while counter-
extension steadies the pelvis, the parts being at the same time coaptated
laterally with a view to the restoration of the displaced bone.  But before the
surgeon makes such an attempt, he should inform the friends of the little
patient of the possibility of the manipulations increasing the lesion and caus-
ing instant death.  A *partial* luxation of the vertebræ, or a luxation of an
oblique process on one side, occasionally occurs, which can sometimes be

reduced in the same manner. The after-treatment consists in rest in the horizontal position, and the employment of means calculated to counteract and subdue the inflammation which will probably arise in the spinal cord or its membranes. Where paralysis occurs after luxation of the vertebræ, it will be requisite to attend carefully to the condition of the bowels and bladder, as in any other case of paralysis of the lower parts of the body.

### § 2.—Luxation of the Ribs.

Luxation of the *head of a rib* from its articulation with a vertebra, though a rare accident, so rare indeed as to be denied by many surgeons, sometimes occurs, as is shown by the specimens to be found in our cabinets. The difficulties in the way of such an accident are apparent when the strength of the articulation of the ribs with the vertebræ is borne in mind, augmented as it is by the interarticular ligament, the articulation with the transverse processes of the vertebræ, and the support afforded by the attachment of the muscles of the back. When the accident occurs, however, it is generally the result of such crushing violence that the constitutional rather than the local symptoms become of importance, and very little can be done in the way of reduction beyond mere coaptation by the fingers of the surgeon. The eleventh and twelfth ribs are those most likely to suffer from this luxation.

Luxation of the **sternal extremity of the ribs** sometimes occurs, and produces a well-marked deformity, which, if the cartilages on both sides are displaced, creates a prominence of the sternum resembling the condition ordinarily known as "chicken breast," a condition also sometimes found in children and dependent on the simple bending or displacement of the cartilages of the sixth, seventh, and eighth ribs.

**Treatment.**—In the treatment of the luxation of the sternal extremity of a rib, the reduction may be usually accomplished simply by pressure on the displaced bone. After reducing the displacement and overcoming inflammatory action, if the deformity is reproduced, compresses and a spiral bandage of the chest may be required ; but usually little can be done to remedy the deformity, the treatment being confined to the relief of the injuries of the internal organs of the chest consequent on the application of the force which created the luxation.

### § 3.—Luxation of the Clavicle.

**Luxation of the Clavicle** may occur at its humeral or sternal extremity. The **sternal end** may be luxated in three directions—forward, backward, and upward. When a luxation forward occurs, there is a prominence upon the front of the sternum due to the presence of the head of the clavicle which can be felt distinctly beneath the skin ; a shortening of the pectoral space, and an inability on the part of the patient to raise the arm in the natural manner. The cause is generally some force applied to the shoulder in such a manner as to force the outer end of the clavicle toward the sternum. In the luxation backward, there is also diminution of the pectoral space and inability to raise the arm, but instead of a prominence, there is a hollow where the head of the clavicle should naturally be found. The luxation upward and toward the opposite clavicle can also be recognized by the position of the head of the bone.

**Treatment.**—In all these luxations of the clavicle the treatment is simple, the arm being used as a lever to draw the clavicle out to its proper length,

while the shoulder is carried in a direction that will correspond with the displacement, extension and counter-extension being made by acting on the shoulder so as to throw the head of the bone back into its place. Thus, in the luxation forward, the shoulder should be carried forward, in order to force the head of the bone backward into its natural position. If the luxation is backward, the shoulder should be carried backward, so as to throw the head of the bone forward into position; while in the luxation upward, the shoulder should be carried upward and outward by means of a pad on the axilla, so as to draw the sternal extremity into its position. The luxation being reduced, the after-treatment consists in the application of some apparatus suitable for the treatment of fracture of the clavicle, as Fox's, Dessault's, etc.: but it is extremely difficult to keep the parts in position, and, in spite of every care, more or less deformity generally results, a fact which the surgeon should bear in mind in his prognosis.

**Luxation of the Humeral End of the Clavicle.**—A dislocation of the **humeral extremity of the clavicle** is occasionally seen, and as its articulating surface is small, any force which ruptures the capsular ligament will prove capable of producing the luxation. This luxation may occur in two directions: in the one the extremity of the clavicle slips above, and in the other beneath the acromion process of the scapula. Both these luxations are extremely easy to reduce. If the scapular extremity of

Fig. 331.



A FRONT VIEW OF THE SPICA BANDAGE OF THE SHOULDER AS APPLIED FOR THE RETENTION OF A LUXATION OF THE HUMERAL END OF THE CLAVICLE.—In its application, commence by applying the Spiral Bandage of the upper extremity, covering in the whole limb from the fingers to the shoulder, so as to protect the skin of the arm from the congestion of its veins. On reaching the shoulder, carry another roller obliquely across the chest round under the sound axilla over the luxated end of the clavicle; thence under the axilla of the injured side, over the point of the shoulder, and then under the sound axilla to follow the same course, each turn covering in two-thirds of the preceding turn, and forming a spica on the shoulder as shown in the cut. (After Nature.)

the clavicle rests on top of the acromion process of the scapula, by elevating the shoulder at the same time that it is drawn outward, the bone will be brought into its place. So when the scapular extremity of the clavicle has slipped under the acromion process of the scapula, by drawing the shoulder outward and depressing it slightly, the end of the bone will start into its place. But the difficulty which will be experienced in the treatment will be found in the fact that, although comparatively

easy to reduce, the bone will again slip out of place so soon as the reducing force is relaxed, and it is often almost impossible to contrive such a dressing as will retain it in position until union occurs in the lacerated ligaments. Fortunately, however, even should the treatment fail to retain the bone in its original position, the usefulness of the limb will only be impaired to a very limited extent.    All the motions of the arm can readily be performed except extreme elevation, and the patient will be able to use the limb in all the ordinary avocations of life.    In a female, however, and particularly in a young female—the trifling deformity which results being apparent whenever she wears a low-necked dress—it becomes a matter of some importance to correct it, and even in a man, the surgeon will always desire to make as complete a cure as possible.    There are but two bandages capable of holding the bone in position : one is the bandage of Velpeau for fracture of the clavicle, the arm being bound to the chest by oblique turns, while the hand of the patient grasps his sound shoulder, Fig. 223, p. 576; the other, that of the spica of the shoulder, Fig. 331, which is, perhaps, the better of the two for cases in which its pressure can be borne.

### ¿ 4.—Displacement of the Latissimus Dorsi Muscle from the Lower End of the Scapula.

There is an injury sometimes alluded to in connection with these luxations, although it does not come within the definition assigned to such injuries, and this is the displacement of the latissimus dorsi muscle.  As the tendon of the latissimus dorsi plays over a triangular surface at the outer side of the inferior angle of the scapula, to which it is more or less firmly attached, it sometimes happens, in consequence of a fall or some other violence, that the muscle slides off this surface and slips down beneath the scapula, causing the patient more or less loss in the power of this muscle in depressing the arm.

**Symptoms.**—This injury may be recognized without any great difficulty by the change in the power of the arm when elevated, and by the unusual prominence of the point of the scapula.

**Treatment.**—To reduce it, draw the arm back so as to relax the muscle as much as possible, and coaptate the parts with the fingers, after which the arm should be retained against the side of the body by circular turns of a bandage, until adhesion of the displaced muscle occurs.

# CHAPTER III.

## SECTION I.

### LUXATION OF THE HUMERUS.

**Anatomical Relations of the Shoulder-Joint.**—In the shoulder-joint the spherical head of the humerus plays against the comparatively superficial glenoid cavity of the scapula, which, although deepened by the glenoid ligament, is yet so shallow that the head of the bone may readily be brought to bear against the capsular ligament, and, if sufficient force is applied, lacerate it and escape from its natural articulating position.

Such an accident would be of daily or hourly occurrence were it not guarded against by the great mobility of the scapula, which gives way before every force in such a manner that it might seem almost impossible to displace the head of the humerus. Statistics, however, show that this luxation is of comparatively frequent occurrence, most probably because sudden forces take the muscles by surprise, and act before they have time to accomplish that adaptation of parts which might prevent the displacement. In considering the anatomy of this joint, with a view to the correct understanding of the manner in which these luxations occur, it should not be forgotten that the surrounding muscles exercise a considerable influence upon the joint by adding greatly to its strength; thus the tendon of the long head of the biceps passes through the joint within the capsular ligament, in its course from its origin from the upper edge of the glenoid cavity to its insertion into the tubercle of the radius, while the supra-spinatus muscle stretches from its origin above the spine of the scapula to its insertion in the greater tuberosity of the humerus, and passing over the top of the joint, and strengthens it above, the function of this muscle being to assist in the extreme elevation of the arm. More superficially, the joint is covered above by the deltoid, while below and laterally are the two teres, the sub and infra-spinati, and the coraco-brachialis muscles.

**Etiology.**—The luxation of the head of the humerus may be caused by two classes of forces: first, those applied directly to the head of the bone, as falls or blows upon the shoulder-joint; and, secondly, indirect violence, such as that resulting from falls upon the hand or elbow, while the arm is carried off from the body, the force being transmitted through the bones of the forearm or arm to the shoulder, and the resistance made by the weight of the body.

**Varieties.**—Luxations of the head of the humerus occur in three directions—the capsular ligament being freely torn in all of them. Thus:—

1. The inferior half of the capsular ligament may be lacerated, and the head of the bone escape down into the axilla, putting all those muscles upon

the stretch, which, like the supra-spinatus and deltoid, tend to hold it up in its natural position.    This is the luxation *downward*.

2. The capsular ligament may be lacerated in front, and a luxation of the head of the humerus *forward* ensue.

3. The capsular ligament may be lacerated posteriorly, and the head of the bone slip out to take a position below the spine of the scapula, this being described as a luxation *backward*.

Besides these entire or complete forms, there may be an incomplete luxation, in which the head of the bone will rest upon the extreme edge of the glenoid cavity.

**Symptoms.**—The first symptoms which should be looked for, in order to establish the presence of any of the varieties of these injuries, are those which may be classified under the general head of deformity.    In order to understand this deformity, and to recognize it when it exists, the natural rotundity and fullness of the shoulder should be borne in mind, as well as the fact that the acromial extremity of the clavicle, and the two tuberosities of the humerus, are naturally on the same level.    Bearing these facts in mind, the presence of the various deformities will be readily recognized.

**Diagnosis.**—Besides the ordinary points of diagnosis which apply equally to all luxations, such as the diagnosis from diseases of the bones, from fracture, etc., it sometimes happens that, owing to a sprain or blow, or an injury of the circumflex nerves, or of causes not precisely understood, an atrophy of the deltoid muscle takes place, in consequence of which a flatness of the shoulder is produced, simulating somewhat the appearances presented by a dislocation.    The diagnosis, however, is easy, as the limb retains almost its natural length ; and although the shoulder is flattened, the fingers cannot be hooked under the acromion process as perfectly as they can be in cases of luxation, nor can the head of the bone be felt in the axilla.

**Prognosis.**—The prognosis of all humeral luxations is favorable, if seen within a month, and unattended by marked inflammation of the surrounding tissues.    If otherwise, the prognosis should be guarded, failure to reduce leaving the motion of the shoulder much impaired.

**Treatment.**—The reduction of all luxations of the humerus may be accomplished by elevation and rotation of the humerus, thus changing the relative distance between the origin of the scapular muscles and their insertion into the tuberosities of the humerus, as will be shown in each variety.

### § 1.—Luxation of the Humerus downward into the Axilla.

**Symptoms.**—When luxation of the head of the bone occurs into the axilla, there is a flatness of the shoulder, the natural rotundity of the joint being destroyed, and a depression created ; the surgeon being able, in thin patients, to hook his fingers under the acromial process of the scapula.    As the deltoid muscle is put upon the stretch by the displaced bone, the arm is usually carried off from the side, while, if the surgeon feels in the axilla, he will there find the head of the humerus, forming a smooth, round tumor, which, in thin subjects, is even readily perceptible to the sight.    Generally there is, in addition, a marked change in the length of the limb, as may be proved by measuring it and the sound limb between two fixed points, as from the acromion process of the scapula to the external condyle of the humerus, measuring first the sound side and afterward the injured one.    In a case of luxation downward in a full-sized adult, the limb will be found lengthened an inch or an inch and a half.    Besides the lengthening of the limb, there is also loss of power, the patient not being able to hold the limb by its own

muscles, and therefore resting the elbow upon his knee, or supporting it with the hand of the opposite side.   If the surgeon seizes the arm and attempts to elevate it quickly, great pain will be caused, in consequence of the pressure of the head of the bone upon the axillary plexus of nerves.   For the same reason, if the luxation continues unreduced for several hours, the patient will often experience a tingling sensation in the fingers, while a certain amount of edematous swelling will ensue, owing to the pressure made by the head of the bone upon the axillary blood-vessels.

Diagnosis.—These symptoms, when taken collectively, are so marked that a case of luxation downward into the axilla can generally be recognized with but little difficulty.   Still, cases are occasionally presented in which, from the swelling caused by effusion into the surrounding tissues, the diagnosis cannot be certainly made ; or difficulty may result from the fact that the luxation is combined with fracture.   In the first case, the measurement of the length of the limb becomes peculiarly useful; in the second, the symptoms of fracture of the neck and head of the bone must be borne in mind.

According to Dugas,* of Augusta, Ga., " if the fingers of the injured limb can be placed, by the patient or by the surgeon, upon the sound shoulder, while the elbow touches the thorax, there *can be no dislocation*, and if this cannot be done, there *must be* a dislocation."

## ? 2.—Luxation of the Humerus Forward.

Luxation forward presents a very different condition of parts.   The capsular ligament in this case is ruptured anteriorly, and the head of the bone escapes anteriorly to take a position on the front of the chest, a little below the clavicle, and directly beneath the great pectoral muscle.   There is another luxation which sometimes occurs, and which is a secondary one, in which the head of the bone leaves this new position, and assumes one higher up and nearer the clavicle.

Symptoms.—When the head of the bone is displaced anteriorly, the elbow is carried off from the side more strongly than in the dislocation downward, and any effort to bring it in toward the chest gives great pain.   The elbow also projects more or less backward.   The deltoid muscle is not put so much upon the stretch as in the last variety, nor is the shoulder so much flattened ; but in a thin person, the fingers of the surgeon may now also be readily hooked under the acromion process, while the roundness caused by the head of the bone may be seen near the position of the coracoid process of the scapula, as is shown in Fig. 332.

Diagnosis.—The fullness caused by the head of the humerus beneath the pectoral muscles, the diminished length of the arm, as measured from the acromion process to the condyles of the humerus, and the symptoms just enumerated, as compared with those of the other varieties, render the diagnosis of this injury comparatively easy.

Prognosis.—The prognosis is that of the humeral luxation downward, this variety being readily reducible to an axillary luxation.

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* Southern Med. and Surg. Journ., vol. xii. N. S. p. 131, 1856, and vol. xiv. N. S. p. 315, 1858.

### ¿ 3.—Luxation of the Humerus Backward.

If the force is applied while the arm is carried across the body, the capsular ligament will give way posteriorly, and a dislocation backward ensue. This deformity, therefore, is entirely different from the last variety. In luxation backward, the elbow goes forward and against the body, while in luxation forward it went backward and from the body. The head of the bone also forms a tumor upon the inferior fossa of the scapula, resting upon the infraspinatus muscle, where, if the patient is comparatively thin, it may be distinctly felt.

Fig. 382.



A front view of the flat appearance of the Shoulder seen in Luxation of the Head of the Humerus forward.

Treatment.—As muscular contraction is the chief obstacle to the reduction of these luxations, it is necessary, in order to understand the manner in which the force is to be applied to reduce them, that their mechanism and the muscular attachments concerned should be thoroughly understood, and a brief reference to this may now be useful to the student.

When the head of the humerus is luxated downward into the axilla, the supra-spinatus muscle is put upon the stretch; it is also spasmodically contracted, and its spasmodic contraction in the new position of the bone serves to draw the head of the humerus firmly up against the inferior edge of the neck of the scapula; hence the spasmodic contraction of this muscle is one of the obstacles which must be overcome in the reduction. Another muscle put upon the stretch, and spasmodically contracted to some extent, is the deltoid, which acts similarly. The other muscles are but slightly changed, the latissimus dorsi and the pectoral being a little relaxed. In the reduction of the luxation downward, means must, therefore, be used to overcome the spasmodically contracted muscles, in order to draw the head of the bone clear of the lower edge of the glenoid cavity; after which, the humerus can readily be carried off from the body, so as to cause its head to ride clear of this edge

back into its place.   In so marked a manner does the contraction of the
supra-spinatus aid in retaining the bone in its unnatural position, that in a
*post-mortem* examination of a patient, who died while laboring under an
unreduced dislocation of the humerus downward, Sir Astley Cooper, though
cutting away the muscles one after another, found himself unable to reduce
the bone until he had divided the tendon of the supra-spinatus muscle.

In the dislocation forward, the supra-spinatus is also put upon the stretch,
but not so much as the infra-spinatus.   The latissimus dorsi is also slightly
stretched or entirely unchanged, while the pectoralis major is much relaxed,
and would be still more so, were it not for the tumor formed beneath its belly by
the head of the bone.   The chief obstacles to the reduction are the contrac-
tions of the supra and infra-spinatus with the deltoid, and the force must,
therefore, be applied in such a manner as to overcome these muscles, in order
to accomplish the reduction.

Fig. 333.
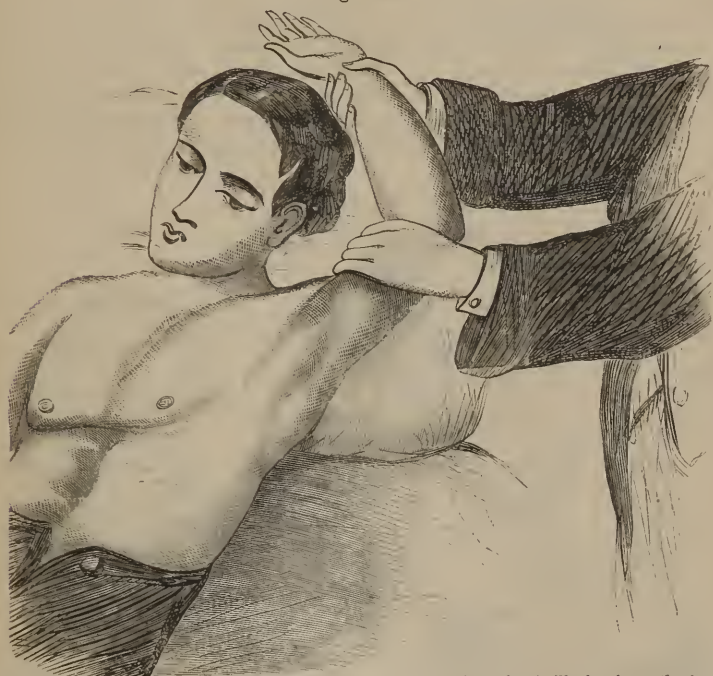


The first step in the reduction of a Luxation of the Humerus into the Axilla, by the author's method,
showing the elevation of the Elbow, and the rotation of the Tuberosities of the Humerus by using the fore-
arm as a lever. (After Nature.)

In the dislocation backward, the supra-spinatus, the subscapularis, and
the teres major muscles, with the pectoralis major, will be stretched, and the
deltoid and infra-spinatus relaxed.

Whatever aids, then, in inducing muscular relaxation must facilitate the
replacing of the head of the bone in its true position ; and there is no
better method of inducing this complete muscular relaxation than by means
of anæsthesia as produced by ether, or ether combined with chloroform in
the proportion of one part of chloroform to three of ether *by weight*, though
much may also be done simply by rotating the head of the humerus so as to
modify the distance between the origin and insertion of the muscles around

the joint, especially those arising from the scapula, and inserted into the tuberosities of the humerus, the normal relations of these muscles being always changed when the head of the humerus leaves the glenoid cavity. Recognizing the influence of position, surgeons have long advocated such plans of treatment as required this, though for a long time the sole idea in the treatment has been to overcome muscular contraction by the application of a force capable of temporarily paralyzing the contracted muscle; hence the use of pulleys and the varied powers of extension and counter-extension in the line of the displaced bone.    Having occasion, in 1858, to treat a luxation of the head of the right humerus anteriorly, the head of the bone resting beneath the clavicle, and under the pectoral muscle, in a very muscular blacksmith, I suggested the following plan of proceeding, which has since so often succeeded as to promise to supersede the old plan by extension and counter-extension.

**Method of the Author, by Rotation and Elevation of the Humerus.—** In the anterior luxation, elevate the elbow as much as possible, and carry it toward the head of the patient, keeping the arm on the line of the body, when the head of the humerus will readily slip into the axilla. In a posterior luxation, elevate the elbow, and carry it forward so as to free the head of the humerus from the edge of the scapula, so as to throw it into the axilla, as has been long practiced.   An anterior or posterior luxation may also be readily converted into an *axillary* or *sub-glenoid*, by elevating the elbow and carrying it backward—the capsular ligament in each luxation being freely lacerated by the injury.

Fig. 334.



The second step in the reduction of an Axillary Luxation, the Elbow being brought toward but not against the side, while the Tuberosities are rotated on the edge of the Glenoid Cavity by means of the forearm as a lever. (After Nature.)

The head of the bone being now mainly held against the neck of the scapula by the contracted supra and infra-spinatus, proceed as follows:—

Elevate the elbow and arm as high as possible, and flex the forearm at right angles with the arm, Fig. 333, p. 719, thus relaxing the supra-spinatus muscle. Then, using the forearm as a lever, rotate the head of the humerus upward and forward, so as to relax the infra-spinatus, carrying the rotation as far as possible, or until resisted by the action of the subscapularis muscle, keeping the forearm for a few seconds in its position with the palm of the hand, looking upward, Fig. 334; then bring the elbow promptly but steadily down to the side, carrying the elbow towards the body, and keeping the forearm so that the palm of the hand yet looks to the surgeon, Fig. 334.    Then quickly but gently rotate the head of the humerus upward and outward by carrying the palm of the hand downward and across the patient's body, Fig. 335, and the bone will usually be replaced.    Should difficulty occur from the marked muscular development, induce anæsthesia.

Fig. 335.



This method of reduction occupies but a few seconds, and may be accomplished while the patient is engaged in conversation.    It consists of three periods: Elevation of the elbow and rotation of the head of the humerus by means of the flexed forearm, Fig. 333; depression of the elbow while retaining rotation of the tuberosity of the humerus, Fig. 334; leverage and elevation of the head of the bone into the glenoid cavity by carrying the arm over the chest and reversing the rotation, Fig. 335.

**After-Treatment.**—Having reduced the luxation, the after-treatment will consist in any means, such as a sling, which will keep the joint at rest until union of the lacerated capsular ligament has occurred; the patient being advised for some length of time to abstain from any motions which would be likely to bring the head of the bone to bear upon the injured portion of the capsular ligament.

Occasionally the injury to the parts surrounding the joint resulting from the force which produced the accident, or from that which is employed in the reduction, causes such a degree of inflammatory action as requires the employment of active antiphlogistic measures.    Thus it may be necessary to cup or to leech around the part, or to apply cold cloths, cloths wrung out of lead-water, etc.

Should paralysis of the limb, either partial or complete, result from pressure of the head of the bone upon the axillary plexus of nerves, those measures must be resorted to which are adapted to local paralysis ; as stimulating liniments, blisters, or blisters dressed with strychnine.    Should these measures fail, much may be done by the judicious employment of electro-galvanism, by cold douches, etc., and in the majority of cases the judicious employment of these measures will ultimately restore the usefulness of the limb.

Paralysis of the deltoid muscle is to be treated on the principles required for the development of the muscles, as friction, cold douches, and electricity, the current being made to pass through the deltoid by applying one pole of the current in the axilla, and the other to the muscle.

### ¿ 4.—Compound Luxations of the Shoulder-Joint.

**A Compound Luxation of the Shoulder** is a dangerous injury, more so even than compound fractures of the neck of the bone.    In its treatment, the parts should first be cleansed thoroughly of all foreign matters, after which the bone should be returned into place, and inflammation actively combated. Should the head of the bone protrude from the wound, and the muscles around it become spasmodically contracted so as to prevent its reduction, the orifice through which it protrudes should be enlarged with a scalpel, sufficiently to enable the bone to be returned into its place, as directed in the case of compound fractures, or the head of the humerus may be sawn off, as in a resection of this bone for disease of the shoulder-joint, though in many instances the perfect relaxation induced by anæsthetics will permit the reduction of the protruding bone.

## SECTION II.

### LUXATIONS   OF THE ELBOW-JOINT.

**Anatomical Relations.**—The elbow-joint is composed of the articulating surfaces of the condyles of the humerus, the head of the radius, and the sigmoid cavity of the ulna, the part of the articulating surface of the humerus in which the olecranon and coronoid processes of the ulna play being called the trochlea, or sometimes the epitrochlea.    The articulation of the ulna with the humerus is strengthened by the anterior, posterior, and lateral portions of the capsular ligament of the joint; by the shape of the olecranon and coronoid processes; and by the attachments of muscles, particularly the biceps, which is inserted into the tubercle of the radius, while the brachialis anticus is inserted into the coronoid process of the ulna.    The radius, which articulates with a little head near the external condyle of the humerus, is bound to the ulna by the orbicular ligament into which many of the fibres of the external lateral ligament are inserted.    This joint presents, therefore, an excellent specimen of the ginglymoid variety of articulations.

**Varieties.**—When a sufficient force is applied to produce a luxation of the elbow-joint, it may occur in three different directions : in the first, both

bones of the forearm go backward, and the coronoid process of the ulna rests in the greater sigmoid cavity of the humerus, Fig. 336; in the second, both bones go outward laterally; and in the third, both bones go somewhat inward. It is nearly impossible that a dislocation of the bones of the forearm forward should occur independently of fracture of the olecranon process.   In the lateral luxations, although both bones are displaced from their natural articulating surface, both are not entirely removed from their connection with the humerus.   Thus, in the luxation outward, the radius is entirely

Fig. 336.



A view of the position of the Bones of the Forearm in the Luxation Backward.

removed from the humerus, while the ulna, though displaced from its position in the epitrochlea, is still in contact with the humerus, resting at a point corresponding with the articulating face for the radius.   So in the luxation inward, the ulna may be driven entirely off the articulating surface designed for it, while the radius, though luxated from its natural position, will still remain in contact with the humerus at a point corresponding with some part of the epitrochlea.

## § 1.—Luxation of both Bones of the Forearm Backward.

The **Luxation of both Bones of the Forearm backward** may be produced by force applied to the hand while the forearm is extended upon the arm, so that the head of the humerus may be brought to bear against the anterior face of the capsular ligament, as when a patient falling forward extends his hands to save himself.

**Symptoms.**—The symptoms are marked.   There is a deformity which is quite characteristic, and which may be described as having a general resemblance to the shape of the heel of the foot, the triceps extensor cubiti, being put upon the stretch and its tendon brought into a position comparable to that of the tendo-Achillis, while the olecranon projects backward after the manner of the os calcis, Fig. 337.   There is pain, which is often very severe, from pressure upon the ulnar nerve, this being sometimes pinched between the two bones, while there is also laceration of the fibres of the muscles and ligaments on the front of the articulation.   In addition, there is more or less loss of motion in the joint, the arm being held in a semiflexed position which admits neither of complete flexion nor extension.   There is also a change in the length of the forearm, as may be proved by taking the measurement of the sound forearm from the internal or external condyle of the humerus to the styloid process of the radius or ulna, and applying the same measurement to the injured limb, when that in the side which is luxated will be found to be shortened to the extent of an inch or an inch and a half.

If a circular line be drawn around the joint through the condyles of the humerus, as was directed in fracture of the condyles, it will also be found that it no longer cuts the point of the olecranon, this being usually found some distance above its normal position.

**Diagnosis.**—The injury most likely to be confounded with this luxation is fracture of the epitrochlea of the humerus, and particularly such a fracture as allows the bones of the forearm to slip backward. The latter case sometimes requires nice discrimination; but a diagnosis can generally be made by a careful examination, because the signs of fracture are superadded to those of luxation. Thus the pain of fracture is present, this being described by the patient as sharp and cutting, while that of luxation is dull and obtuse; and in drawing the circular line around the elbow-joint it will be observed that one of the condyles is out of line as well as the olecranon process. But the most satisfactory diagnostic mark is, that while the luxation when combined with fracture can be reduced with ease, yet upon removing the extending and counter-extending force the deformity is at once reproduced by muscular action. A simple luxation also requires more force to reduce it than one consequent on a fracture, while it also retains its position after the reduction, which one due to a fracture does not.

Fig. 337.
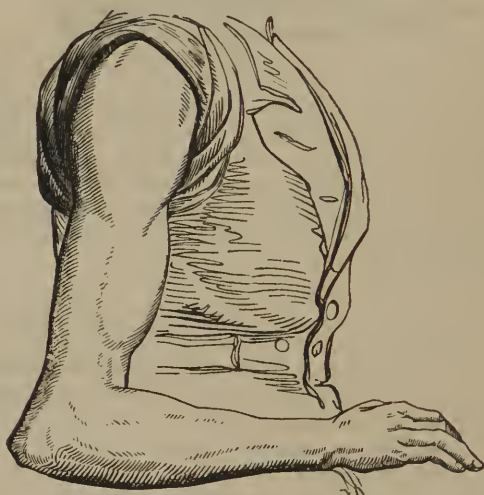


A side view of the appearance of the Elbow-Joint when both Bones of the Forearm are Luxated Backward—showing the Lengthening of the Elbow and the Shortening of the Forearm.

**Prognosis.**—When recent, the prognosis of this injury is favorable, but a case of a few weeks' standing will be of doubtful success, owing to the changes, adhesions, etc. induced by inflammation.

**Treatment.**—In the luxation of the bones of the forearm backward, as the contraction of the biceps and brachialis anticus pull the coronoid process of the ulna violently against the humerus, thus preventing the reduction, force must be employed to draw the bones off from the humerus, that they may be slipped forward into place. This may be done by etherizing the patient thoroughly, and then, seizing the forearm with one hand, draw upon it, while an assistant draws upon the humerus, so as to make counter-extension; then, flexing the forearm, reduction will generally be accomplished. But if this is not sufficient, or if from any cause anæsthetics cannot be resorted to, two towels may be folded and placed one around the arm and the other around the forearm, and be confided to two assistants, the strongest assistant seizing that attached to the forearm. Then, while the extension and counter-extension is made by the assistants, let the surgeon forcibly flex the forearm,

when the luxation will hardly fail to be reduced.    In many instances, however, even without etherization, all that is necessary to reduce this luxation will be for the surgeon to make extension, by drawing on the forearm with his hands at the same time that he flexes the forearm forcibly over his knee, or around a padded bed-post, which thus answers the purpose of counter-extension and flexion.

**After-Treatment.**—Apply a roller lightly from the fingers up to the middle of the arm, and dress the limb with an angular splint on the *front* of the arm, as directed for fractures of the condyles; making passive motion every three or four days, to guard against anchylosis.

### § 2.—Lateral Luxation of the Elbow.

The **Lateral Luxations of the Elbow** are of rare occurrence.

**Etiology.**—They are produced generally by a force applied laterally while the arm is flexed.

**Symptoms.**—There is an increased width of the joint, distinguishable from that of fracture of the condyles by the fact that the olecranon process or the head of the radius can be felt projecting abnormally on one side of the articulation, this injury being also unaccompanied by the acute pain which always attends a fracture.

**Prognosis.**—The prognosis in lateral luxations of the elbow-joint should be guarded; for, although if the character of the injury is recognized, it can generally be reduced and deformity avoided, yet anchylosis more or less complete is very liable to occur, from the laceration of the ligaments of this close articulation.    To prevent dissatisfaction, the patient should always be informed of the possibility of this at an early period.

**Treatment.**—The lateral luxations of the elbow are to be reduced by the application of force in a lateral direction, while the forearm is flexed upon the arm.    The force may be produced by one towel passed around the fore-arm, and another around the arm, and confided to the hands of an assistant, sufficient extension and counter-extension being kept up at the same time to prevent the bones binding against each other.

### § 3.—Luxation of the Head of the Radius.

The head of the radius may be luxated without involving the articulation of the ulna with the humerus.    This luxation is described as occurring forward or backward.    When it occurs backward the biceps, which is inserted into its tubercle, is put upon the stretch, while in the luxation forward this muscle is relaxed.

**Etiology.**—The luxation backward is generally caused by falls upon the hand when in extreme pronation, while the luxation forward occurs when the hand is in extreme supination, or sometimes the backward luxation has been produced by violent muscular efforts, as in the case of washerwomen wringing clothes.    Both accidents are of rare occurrence, so much so that their existence has been denied by some surgeons, though I have four or five times treated this injury.    The luxation backward is the more common.

**Symptoms.**—A careful examination of the elbow-joint will generally reveal the nature of the accident; in the luxation backward, the hand will be found strongly pronated, while after luxation forward, forced supination of the hand will be observed.

**Treatment.**—The reduction is accomplished as follows: In the luxation

backward, flex the forearm upon the arm to relax the biceps, and bring the hand from pronation into forced supination; but in the luxation forward the forearm should be extended, and the hand carried from supination into forced pronation. It is evident, therefore, that it is a matter of considerable importance to distinguish between these two accidents, for nothing but failure could be anticipated should the surgeon attempt to reduce the luxation backward with the manipulations appropriate to the displacement forward.

### § 4.—Luxation of the Ulna.

**Luxation of the Ulna,** by itself, from its articulation with the humerus, is a rare accident; though it sometimes occurs. When it is created, the symptoms so precisely resemble those of the luxation of both bones backward, and the treatment is so much the same, that no further reference than the mere mention of the possibility of the accident is required.

## SECTION III.

### LUXATIONS OF THE WRIST.

**Anatomical Relations.**—The wrist-joint is formed by the articulation of the radius and ulna with the first row of the carpal bones. Although it is not necessary to go minutely into its anatomy in this place, yet it may be mentioned that the capsular ligament, which is loose and comparatively feeble, is strengthened by the internal and external lateral ligaments, by the sacciform ligament, and by the presence on the palmar surface of the flexor, and on the dorsal surface of the extensor tendons. Special luxations of the radius or of the ulna alone at the wrist-joint are, moreover, somewhat guarded against by the attachments of the pronator quadratus muscle, which binds the two bones together, and tends to prevent such an accident.

**Varieties.**—Four luxations of the wrist-joint are usually described by writers; thus we are told of luxations forward and backwack, as well as of two lateral luxations. These accidents, when met with, are so generally created by extreme violence, that the opinion has already been expressed, in connection with the subject of Barton's fracture, that they are rare when unaccompanied by fracture, if, indeed, they ever occur, except from the application of great force. The remarks now made refer, therefore, less to such luxations as are the result of simple violence than to a class which present the effect of a peculiar train of circumstances. Thus, if certain predisposing causes, as paralysis or preternatural relaxation of the ligaments of the wrist, exist, or if an individual has labored for a considerable length of time under a spasmodic contraction of certain muscles, or if sudden force is applied to the hand, a luxation may undoubtedly ensue and be unaccompanied by fracture, and this may occur in any of the four directions above alluded to.

**Treatment.**—When a luxation forward occurs, that is, when the bones of the forearm go forward, and those of the carpus go backward, the hand is violently extended, the flexor tendons stretched, and there will be a considerable prominence on the back of the wrist. Such a luxation is readily reduced by carrying the hand forward while a moderate degree of extension and counter-extension is made. In the luxation of the bones of the forearm backward, in which the bones of the **carpus** are displaced forward, the hand will be flexed, the extensor tendons put upon the stretch, and the

tumefaction be upon the front of the hand.   In such a case, extension and counter-extension should be made, and the hand carried in the opposite direction to that given for the last injury.   After the reduction in either injury the parts should be kept as much at rest as possible, and inflammation be actively combated.   Should the luxation have resulted from violence, as is usually the case, the inflammation will often run so high as to induce sloughing of the integuments over the joint, or caries of its bones.

### ⸹ 1.—Luxation of the Lower End of the Ulna only.

**Luxation of the inferior extremity of the Ulna by itself** is an injury which sometimes occurs as a result of violence, or is caused by falls, etc. In order to permit it, the sacciform ligament must be considerably lacerated or entirely ruptured.

**Treatment.**—Extension and counter-extension, properly applied, will be sufficient to reduce the injury, and a compress and roller will retain the displaced bone in position.

## SECTION IV.

### LUXATION OF THE CARPAL BONES.

The **Bones of the Carpus** are sometimes luxated.   Generally, however, the force which displaces one of these little bones produces also such an injury in the soft parts as induces a degree of inflammation which renders attention to the latter the most important part of the treatment; and nothing in the way of reduction, except a moderate degree of coaptation, can be effected.

### ⸹ 1.—Luxation of the Os Magnum.

The **Os Magnum,** however, is sometimes the seat of a simple luxation. The head of the magnum, when luxated from its articulation with the first row of carpal bones, presents a small tumor on the back of the wrist, and is to be reduced by making moderate pressure with the thumb upon the bone, while at the same time the surgeon makes flexion and extension of the hand ; after which the parts should be kept at rest, and inflammation combated.

### ⸹ 2.—Luxation of the Os Pisiforme.

The **Os Pisiforme** is also sometimes luxated, an accident which becomes important, on account of its relaxing the tendon of the flexor carpi ulnaris, which is inserted into it.   This luxation is to be reduced by simple manipulation, but, like the accident last described, is comparatively rare.

## SECTION V.

### LUXATION OF THE METACARPAL BONES.

The **Metacarpal Bones** may be luxated from their connection with the carpus.   The metacarpal bone of the thumb is, however, the only one

which would be likely to be displaced, except as the result of such a force as would produce a compound luxation. They may also be luxated at their phalangeal articulations.

### ¿ 1.—Luxation of the Metacarpal Bone of the Thumb.

**Luxation of the Metacarpal Bone of the Thumb at its Superior End** upon the carpus is sometimes quite troublesome. It may be caused by a fall, or any similarly applied force; and, when it occurs, happens generally in one of two directions, either forward or backward. This fact, also, is to be noted in luxations between the inferior end of the metacarpal of the thumb and its first phalanx, as well as in the phalanges of all the fingers, the great strength of the external and internal lateral ligaments, as compared with the capsular ligament on the posterior and anterior face of the joint, preventing lateral displacement.

When the luxation occurs at the metacarpo-phalangeal articulation of the thumb, the end of the phalanx, corresponding in its general shape with the head of the tibia, rides over the head of the metacarpal bone, com-

Fig. 338.



A view of the relations of the Bones in a Luxation of the Phalanx on the Metacarpal Bone of the Thumb.

parable in shape to the rounded head of the condyles of the femur, and the inequalities of the surface prevent reduction, unless the two bones are separated by a proper extending and counter-extending force, or the lower bone is made to describe the arc of such a circle as will free these prominences, Fig. 338.

**Treatment.**—The best method of reducing this luxation is by the manipulation suggested by Crosby, of New Hampshire, and first published by his pupil, Dr. Doe, of Vermont.* This is as follows: Let the surgeon seat himself so as to face in the same direction as the patient, and place the patient's hand upon his knee. Then, turning back the phalanx of the thumb, so that it will form more than a right angle with its metacarpal bone, let him place both of his index fingers against the ball of the patient's thumb, while he presses the ends of both his own thumbs against the projecting end of the luxated phalanx, pushing it forcibly forward until the head of the phalanx slips over the end of the metacarpal bone into its place, as may be readily accomplished with but little pain to the patient. A reference to Fig. 339 shows how readily the natural relations of the bones may be established;

Fig. 339.



* Am. Journ. of Med. Sciences, April, 1853, p. 401.

while Fig. 341, shows the manipulation.   In the *Boston Medical and Surgical Journal*, vol. lvii. No. 9, Benjamin Cutter, of Woburn, Mass., has also

Fig. 340.



The Phalanx as reduced.

urged the advantages of the plan, giving the credit of the suggestion to Crosby, of Hanover, N. H.   The simplicity and excellence of this method

Fig. 341.



A view of the Manipulation practiced in Crosby's method of reducing Luxations of the Thumb.
(After Nature.)

of reducing this troublesome luxation is one of the improvements in surgery induced by the substitution of judicious manipulation for mere mechanical extension.

# CHAPTER IV.

## LUXATIONS OF THE LOWER EXTREMITIES.

LUXATIONS of the articulating surfaces of the bones of the lower extremities present a class of injuries which are much more serious than the luxations previously described, the reduction being more difficult, the accompanying symptoms more severe, and the consequences, when they are improperly treated, more important.

## SECTION I.

### LUXATION OF THE HIP-JOINT.

**Anatomical Relations.**—The *hip-joint* is formed by the articulation of the round head of the femur with the deep cavity of the acetabulum; a cavity which possesses considerable depth in the skeleton, but which is still further deepened in the patient by the cotyloid ligament surrounding its edge. The head of the femur is held securely in this deep socket by a strong capsular ligament, and by the ligamentum teres or round ligament which passes between the head of the bone and the bottom of the acetabulum. In addition to these ligaments, the articulation is materially strengthened by powerful muscles which surround it, such as the glutei and psoas magnus muscles, the pyramidalis, gemini, obturators, quadratus femoris, and the powerful muscles of the front and inside of the thigh, as the rectus, adductors, etc. All these render this articulation so firm that the femur is seldom displaced, unless the muscles are taken by surprise, and the force producing the luxation is not only great but sudden; or unless the head of the femur or the articulating cavity of the innominatum are altered by disease, so as to permit the action of the muscles to create the displacement.

**Varieties.**—Luxations of the head of the femur may occur in four different directions, and these may be arranged into two classes for the purposes of study. The four varieties of this luxation may therefore be divided into two: first, those in which the head of the bone goes backward; and second, those in which the head of the bone goes forward of the acetabular line, thus making two varieties of each class.

This classification, it must be admitted, is not strictly accurate, yet is it sufficiently so to facilitate the investigation of the symptoms of each variety, and aid the memory in recalling them. It may also be stated—although, like the classification given above, it must be taken with some modification—that all the luxations backward turn the toes and the foot of the injured side more or less inward, while all those in which the head of the femur passes forward, or in which it takes a position anterior to the acetabulum, turn the toes more or less outward; in the posterior luxation, the foot is inverted, in the anterior, it is everted.

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The varieties above alluded to may then be enumerated as follows :—

**Backward.**—1. *Luxation upward and backward upon the dorsum of the ilium*, the head of the femur resting just behind the anterior inferior spinous process.

2. *Luxation downward and backward into the ischiatic notch.*

**Forward.**—3. *Luxation upward and forward upon the pubis.*

4. *Luxation downward and forward into the thyroid foramen.*

To these there is sometimes added a fifth variety, or one in which the head slips into the *sciatic notch*.

### § 1.—Luxation of the Head of the Femur upward and backward upon the Dorsum of the Ilium.

**Etiology.**—The causes which produce this luxation are such as apply force from below upward, while the limb is carried across its fellow. It is accordingly found to result from falls, and particularly from falls upon the knees while the patient is carrying heavy weights, etc.

**Symptoms.**—The symptoms of this luxation are as follows : There is shortening, which is sometimes inconsiderable at first, but becomes very marked in a few hours, varying then from an inch and a half to two inches and a quarter, as ascertained by measurement made in the manner directed under the head of fracture of the thigh ; or, if the force producing the luxation also forcibly adducts the limb, the short-ening will be marked from the first moment after the accident. The foot is strongly inverted, the toes pointing toward the instep of the opposite foot, or resting upon it, Fig. 342. The limb is also very much adducted and carried toward its fellow, so that the knee rests upon the inner and under side of the opposite thigh. There is, moreover, an unnatural prominence upon the dorsum ilii, caused by the presence of the head of the bone beneath the muscles, a deficiency in the prominence of the trochanter major, and an unnatural flatness over the cavity of the acetabulum, which, in a lean individual, may be distinctly felt. The trochanter major can also be felt much closer to the anterior superior spinous process of the ilium than it is in the normal condition of the joint.

There is a total absence of crepitation, though sometimes a crackling can be heard in the neighborhood of the injured joint, which might mislead a young surgeon ; but experience will recognize at once that it is the soft crackling of synovial or other liquid effusions, and totally different from the crepitation of fracture.

The patient usually complains of considerable pain, particularly when the parts are put upon the stretch by any motion, such as that made by the surgeon in examining the parts.

Fig. 342.



A front view of the Appearances in a Luxation of the Femur upward and backward on the Dorsum of the Ilium.

**Diagnosis.**—With such symptoms, there can hardly be any difficulty in

making out a diagnosis under ordinary circumstances, especially if the patient is seen soon after the occurrence of the injury. In the injuries of the hip of some standing, the diagnosis is often, however, extremely difficult, it being almost impossible sometimes to decide whether the case is one of luxation or fracture. From fracture of the neck of the femur, which is the condition most likely to be confounded with it, the luxation upward and backward can generally be distinguished by the fact that in fracture the shortening is readily reduced, though it is reproduced so soon as the extending and counter-extending forces are removed; whereas in dislocation the deformity is reduced with much greater difficulty, the bone being likely when reduced to remain in place. The diagnosis from the luxation which sometimes occurs in *morbus coxarius*, as a result of change of structure, will be given under the latter head.

**Mechanism.**—With regard to the manner in which the muscles concerned are affected, it will be readily understood that the glutei muscles arising from the ilium and inserted into the trochanter major are very much relaxed, while the small rotatory muscles are put upon the stretch, or even more or less lacerated. The iliacus internus and psoas magnus are also violently stretched, and the lower adductors are more or less relaxed.

**Treatment.**—Few surgeons of the last two hundred years have probably ever been called on to attempt the reduction of a luxation of the femur, without having vividly brought before their minds the powerful muscles the spasmodic contractions of which, it was admitted, kept the luxated bone in its unnatural position. Impressed with this idea, the necessity of resisting muscular contractility by mechanical force, and augmenting it until the power of the muscles was sufficiently overcome to permit the reduction of the displaced bone, was always strongly insisted on as the prominent indication in the treatment, though from time to time suggestions were made of the efficiency of certain manipulations in facilitating the extension and counter-extension in the reduction of the bone. It remained, however, for Wm. W. Reid, of Rochester, in the State of New York, to give such ideas a definite shape, and to prove that a luxated femur, even in muscular individuals, and when displaced for several weeks, could be easily reduced in a few minutes by gentle manipulation, with but little pain to the patient, and with great ease to the surgeon, as compared with the heavy labor of thirty minutes or an hour formerly required of him. In consequence of this valuable suggestion of Reid, the practice of surgeons prior to the year 1850 will probably be entirely laid aside; pulleys, straps, hooks, sheets, etc. placed upon the shelf; and the former means of reducing luxations of the femur be hereafter looked on with the same feeling that a traveler regards the instruments of torture in the old Spanish inquisitions. In fact, the nineteenth century in surgery will be sufficiently noted for its improvements, if nothing else is developed than the inhalation of ether, and the admirable mode of reducing luxations of the femur suggested by Reid.

**Reid's Plan of Reducing a Luxation of the Femur upward and backward on the Dorsum of the Ilium,\* solely by Manipulation.**—"Place the patient on his back, on a low firm table, or, what is better, upon a quilt folded and laid on the ground. Let the operator stand or kneel on the injured side and seize the ankle with one hand and the knee with the other. Then flex the leg on the thigh; next strongly *adduct* it, carrying it over the

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\* Transactions of the Medical Society of the State of New York, February, 1852, p. 25, but previously presented to the Monroe County Medical Society, May 8, 1850, and published in the Buffalo Medical Journal, August, 1851, as well as in the Boston Journal.

sound one, and at the same time upward over the pelvis by a kind of semi-circular sweep as high as the umbilicus. *Then abduct* the knee gently, turn the toes outward, the heel inward, and the foot across the opposite and sound limb, making *gentle oscillations of the thigh*, when the head of the bone will slip into its socket with a slight jerk, or an audible snap, and the whole limb will slide easily down into its natural position beside the other. In a recent case the whole operation can be accomplished in less time than it can be described."

Fig. 343.



A VIEW OF THE POSITION OF THE SURGEON AND PATIENT, IN THE ACT OF REDUCING A LUXATION OF THE FEMUR UPON THE DORSUM OF THE ILIUM.—The thigh being flexed on the pelvis, and the leg bent on the thigh, the surgeon is in the act of drawing the knee toward him with one hand, while with the other at the ankle he rotates the head of the femur into the acetabulum by the gentle oscillatory movement described in the text. (After Nature.)

The advantages claimed by Reid for this method are such as my experience of it in several instances strongly confirms.

1. It is simple.   2. The movements are natural.   3. There is little or no pain.   4. There is neither tonic nor involuntary spasms to contend with. 5. It is better adapted to and more certain of success in cases of long standing than extension by the pulleys.   6. It is free from danger under all circumstances, *provided* Reid's directions are accurately observed.   "A rocking motion of *the leg* while the thigh is being brought to the *straight position* and strongly abducted," is objected to by him, as a source of failure in the manipulation, if not of danger.*   "When the thigh is flexed on the trunk, say at an angle of 45°, and is gently *abducted*, and the head of the bone thus brought close to the lower edge of the acetabulum, if, while gentle oscillations of the thigh are made at the knee, the head of the femur does not immediately enter the socket, the knee should be alternately elevated and depressed, thus varying the angle of the thigh.   If by this manœuvre,

* New York Journ. Med., July, 1855, p. 66.

alternated with the before-mentioned oscillating or lateral movement, the head does not enter, we should then cease all motion and hold the thigh and leg perfectly quiet for a short period, keeping the former still slightly abducted, so that all the muscles, etc. may become quiescent. The foot and leg must be kept still also, and firmly directed toward the opposite thigh; for if we relax or carry it outward, we shall roll the head of the femur away from its resting-place and proximity to the acetabulum, and permit or provoke the muscles to draw it into the foramen ovale, ischiatic notch, or dorsum ilii. After a short time we may repeat our attempts, and in all suitable cases of from four to six weeks' standing, confidently antici-pate a speedy and favorable issue."*

The importance of carrying out directions accurately cannot be too much insisted on in all operations, but especially in those which are novel, and I have, therefore, given Reid's own account in order that errors may be avoided. I have, in numerous instances, employed his method with success, two of the cases being on the dorsum of the ilium, one into the sciatic notch, one into the foramen thyroideum; and in May of 1852 reduced, before the Medical Class of the University of Pennsylvania, a luxation of eleven weeks' standing, in a boy fourteen years of age. The facility with which a lux-ation on the dorsum of the ilium could be converted into one in the sciatic notch, first struck me in this case; and it is not the least extraordinary part of this manipulation that the surgeon can readily convert any one form of luxation of the femur into another and then reduce it. In all instances in which I have resorted to Reid's manipulation, I have first etherized the

Fig. 344.



A side view of the Position of the Patient, of the Counter-extending Band (a), of the Extending Band (b) as made fast by a clove hitch above the knee, and of the Attachment and Position of the Pulleys (c) as formerly deemed necessary for the reduction of a luxation of the femur, the patient being at the same time bled ad deliquum animi, nauseated with tartar emetic, etc.

patient, though I am satisfied that it can be done, as he advises, without inducing anæsthesia. My chief object in the etherization has been to pre-vent any straining and save the patient inconvenience, believing that the manipulation is so perfect that no muscular action is required to replace the bone, the latter being carried into the acetabulum as it would be by similar manipulation on the skeleton. By the inconsiderate action of the lever force obtained in Reid's method, one of three accidents may result: 1. The muscles may be torn from their attachments. 2. The parts through which the head of the bone moves may be torn. 3. The neck of the femur may be broken. Gentleness and a strict observance of the method is necessary.

With a view of contrasting the ease and simplicity of Reid's method, when properly employed, with the plan which has been resorted to for years—each generation having apparently worked in the footsteps of those who preceded them—the position of the patient, as he lies stretched between the powerful action of the pulleys and the counter-extending band in his perineum, is shown on the opposite page. Even with this powerful extension it was often found impossible to stretch the limb, while, if the head of the femur hitched on the edge of the acetabulum and was drawn in an incorrect line, fracture of the neck of the femur was liable to be produced.

**After-Treatment.**—After the reduction of a luxation of the femur, the two limbs should be tied together and the joint kept at perfect rest for ten days or two or three weeks, in order that the lacerated capsular ligament may be allowed to heal. Should violent inflammation show itself around and within the joint, cups or leeches to the part, with the cold water-dressing and purging, may be demanded.

### § 2.—Luxation of the Head of the Femur on the Pubes.

In the luxation forward of the femur upon the pubes, the head of the bone takes a position that is easily recognized, though this form of luxation is rare.

**Etiology.**—The causes of this luxation consist in the application of a force so that the head of the bone will be driven upward and forward, while the foot is advanced, as in stepping into a hole, especially while carrying a weight on the shoulders.

**Symptoms.**—The symptoms are very marked; thus, the limb will be thrown into the characteristic position seen in Fig. 345, being carried off from its fellow, the foot everted, the toes especially being turned strongly outward, so as to bring the heel into such a position that if the leg was slightly flexed upon the thigh, it would rest upon the instep of the sound limb.

The injured limb is slightly shorter than the sound one, the degree of shortening varying according to the circumstances of the case. If the head of the bone rests simply upon the front of the pubis, the shortening will be about one inch, this being most frequently the case; but if the femur has slipped up and taken a consecutive position anteriorly and just below the anterior superior spinous process of the ilium, the shortening becomes greater. This consecutive dislocation is generally accompanied with considerable laceration of the capsular ligament, as well as of the muscles inserted near the neck of the bone. The round ligament is also ruptured in this as in others of the complete displacements of the head of the bone. If the patient is thin, the head of the bone may be seen forming a tumor over the pubis, and its movements can be distinctly felt under the skin by the surgeon.

Fig. 345.



A front view of the Position of the Limb after a Luxation of the Femur on the Pubis. (After Cooper.)

The patient suffers considerable pain, which is often very severe in its

character, from the pressure of the head of the bone upon the anterior crural nerves.

**Diagnosis.**—The absence of crepitus and the permanent position render the diagnosis of this luxation from a fracture quite easy.

**Treatment.**—The reduction, according to Reid's plan, would be one of simple manipulation; the patient and surgeon being placed as directed in the reduction of the luxation upward and backward, the limb should be strongly abducted, and the foot rotated still more strongly outward, so as to make the trochanter act as a fulcrum, and pry the head of the bone off from the pelvis, when it will slip into the foramen thyroideum. The thigh should then be strongly flexed on the pelvis, and be carried across its fellow, when, by rotating the leg outward, so that the sole of the foot will look outward and upward, the head will be made to describe a semicircle backward, till, coming over the acetabulum, it will suddenly slip into its place.

### ¿ 3.—Luxation of the Femur into the Foramen Thyroideum.

Sometimes the head of the bone slips out of the acetabulum, and takes a position lower down than that just described, slipping into the **Foramen Thyroideum.** This luxation, though also rare, is more common than that on the pubes.

Fig. 346.                                    Fig. 347.



Fig. 346.—A front view of the Position of the Limb in a Luxation into the Foramen Ovale or Thyroideum.
Fig. 347.—A front view of the Position of the Limb in a Luxation Backward into the Ischiatic Notch.

**Symptoms.**—When a luxation of the femur into the foramen thyroideum occurs, the limb is lengthened about two inches, the amount of this elongation being equal to the distance of the centre of the foramen thyroideum below a horizontal line drawn through the centre of the acetabulum. The

foot is neither inverted nor everted, as a general rule, though it will be found much easier to evert than to invert it. The **head of the bone** may be felt in its unnatural position in thin persons, and the thigh is so much abducted that it cannot be brought near its fellow. When the patient stands upright, the injured limb assumes a position which is quite characteristic, being shot out in advance of the body (Fig. 346) and considerably lengthened. The muscles put upon the stretch are the glutei and the small rotatory muscles in the back of the thigh, while the adductors and pectineus are relaxed.

**Treatment.**—Like the two luxations before described, that into the thyroid foramen may be reduced by simple manipulation, consisting in flexing the thigh on the pelvis, carrying it across its fellow, and giving to it a certain amount of circumduction which slips the head of the bone into its place.

### § 4.—Luxation of the Femur into the Ischiatic Notch.

This luxation, which is more frequent than the two preceding displacements, is that in which the head of the bone goes **backward into the ischiatic notch.**

**Etiology.**—In order to produce this luxation, the force must be exerted so as to cause the head of the bone to bear against the posterior part of the capsular ligament. In two cases which came under my notice, one was the result of the patient slipping while rolling a bale of cotton up an inclined plane, the bale rolling back and striking against the knee, while another bale behind the pelvis held him stationary. The other occurred while the patient was coupling two railroad cars, the hind car striking the pelvis while the knee was bent and fixed against the bumper of the front one.

**Symptoms.**—When such a luxation occurs, the limb is slightly shortened, being usually from half an inch to an inch shorter than its fellow; and the toes are turned inward, so that the great toe rests on the ball of the great toe of the other foot, Fig. 347. The head of the bone may also be felt in a thin patient, if seen early after the accident, but otherwise it is difficult to recognize it, owing to the thickness of the glutei muscles. The muscles whose actions are to be overcome in this case are the rotatory muscles, as the pyriformis, gemini, obturators, etc., the gluteus magnus muscle being relaxed.

**Treatment.**—To reduce this luxation by manipulation, the thigh must be flexed on the pelvis, and carried across its fellow, when it should be slowly abducted from the body, in a manner very similar to that directed in a case of luxation upon the dorsum ilii.

**After-Treatment.**—In this, as in the other luxations, it will become necessary, after the reduction is effected, to combat inflammatory action, the two limbs being brought together and fastened, if the patient is restless, with a handkerchief or a bandage, and such antiphlogistic measures employed as the degree of inflammation demands.

### § 5.—Congenital Luxation of the Hip-Joint.

**Etiology.**—Under the designation of congenital luxation of the hip, is described a condition sometimes seen in children within two years of age, when it may have been caused by violence due to accident, or ensue on partial paralysis, the latter coming under the designation of spon-

taneous rather than under that of congenital luxation.   That such a dis-
placement may occur, considerable relaxation of the muscles and liga-
ments surrounding the hip-joint must be present; and hence the condition
generally arises from some want of innervation, or is the result of injury to
the spinal cord, or disease in the acetabulum or head of the femur.

**Symptoms.**—This luxation presents very much the same symptoms as
those already described—the position of the head of the femur being most
frequently on the dorsum of the ilium.

**Prognosis.**—These cases are usually difficult to treat, and no positive
plan of treatment can, in fact, be suggested, the luxation being generally
reducible, but difficult to keep in place.

**Treatment.**—The treatment consists in reducing the bone as before
directed, and in the employment of a splint for a few weeks, with the use
of such measures as are calculated to improve the general health—cold
bathing, tonics, and chalybeates being most beneficial.   If the disease is
dependent upon the tuberculous diathesis, as is sometimes the case, such
measures as are required in the treatment of morbus coxarius will be
necessary.

## SECTION II.

### LUXATION OF THE KNEE-JOINT.

**Anatomical Relations.**—The knee-joint is formed by the articulation of
the condyles of the femur with the head of the tibia, and strengthened by
the position of the patella anteriorly.   It has no proper capsular ligament,
as its place is supplied by a structure formed principally at the expense
of the fascia, to which the term involucrum is applied.   As this does
not furnish sufficient support for the joint, a strong external and internal
lateral ligament aids in binding the bones together, while the strength of
the articulation is increased by the flexor and extensor muscles which pass
anteriorly and posteriorly to the articulation.   Within the joint are the
crucial ligaments, two stout ligamentous cords, which, arising from the
condyles of the femur, are inserted in front of and behind the spinous pro-
cess of the tibia, to which, also, the semilunar cartilages are attached.

### ¿ 1.—Luxations of the Knee.

**Luxations of the Knee-Joint** may happen in four different directions: in
the first, the head of the tibia goes backward, while the condyles of the femur
slip forward; the second is the reverse of this, the condyles of the femur
going backward; besides which two lateral subluxations are usually alluded
to by surgical writers, and regarded as of more frequent occurrence than the
anterior and posterior, owing to the great depth of the head of the tibia
presenting an extensive support to the condyles of the femur in all the
motions of flexion and extension of the leg on the thigh.

These accidents are not uncommon as a result of disease in the bones or
of the articulation, but they are rare as a result of the application of force
on account of the peculiar formation of this articulation.

**Etiology.** — In order to produce any of them, a force must be applied
which will create a strain upon the ligaments upon that side of the articula-
tion toward which the bone slips.   Every luxation, therefore, of the knee-
joint will be accompanied with more or less laceration of the ligaments,
and of the synovial membrane, and every complete luxation will be accom-

panied by a laceration also of the crucial ligaments, in consequence of which the patient will be liable for a considerable period after the injury—or until the ligaments have completely united—to a reproduction of the injury. Owing to the laceration of the synovial membrane, there will also be more or less inflammation in the joint, and this is extremely liable to terminate in anchylosis, partial or complete, if it does not result in suppuration within the cavity of the joint.

Treatment.—To reduce a lateral luxation of the knee-joint, a considerable amount of extension and counter-extension is necessary, and while this is kept up by assistants the surgeon should accomplish the reduction by judicious lateral pressure.

To reduce the luxation forward or backward, extension and counter-extension will also be necessary, but here the surgeon must apply his pressure anteriorly or posteriorly, as the case may be, so as to force the bones into the proper position. It is seldom that any great difficulty occurs in carrying out these principles and effecting the reduction if the patient is thoroughly etherized. The difficulty experienced is of another character, consisting principally in the evils resulting from the inflammation caused by the laceration of the ligaments and the pinching of the synovial membrane in the efforts made in accomplishing the reduction. Great attention to the after-treatment, therefore, becomes necessary; the inflammation being actively combated by leeches, and the whole antiphlogistic treatment vigorously carried out, the limb meanwhile being kept at perfect rest. But, after two or three weeks, when the tendency to inflammation has subsided, and union of the lacerated ligaments has perhaps occurred, passive motion may be gently made and patiently persevered in, to break up any adhesions which may have already formed. Should inflammatory action have run high, and continued for such a period that false anchylosis has already occurred before the surgeon is able to employ passive motion without creating acute pain, such an instrument as is recommended for the gradual production of motion at the joint may be resorted to, as will be described in connection with the subject of anchylosis.

### § 2.—Luxations of the Patella.

Besides the luxations of the knee-joint, just described, those of the **Patella** alone sometimes occur.

Varieties.—There are three varieties of this luxation : in the first, the patella is luxated inward ; in the second, outward ; while the third, which is sufficiently rare, consists in a rotation of the bone upon its perpendicular axis, so that its anterior face is turned partly in toward the articulation, while its posterior surface is turned partly out toward the front of the limb, one of its edges being prominently presented to the condyles or epitrochlea of the femur.

Luxation of the patella upward or downward cannot, of course, occur without a laceration of the ligament of the patella, or of the tendon of the quadriceps femoris muscle, unless there is a preternatural relaxation of these parts. Compound luxations of the patella sometimes occur and require, after the luxation has been reduced, the observance of an active antiphlogistic treatment. It is always a very serious injury, and is exceedingly apt to result in amputation or anchylosis.

Etiology.—The causes of lateral luxation of the patella are generally such forces as blows or falls applied laterally, while the muscles are relaxed in consequence of the leg being fully extended. The rotation of the patella upon its axis, on the contrary, is generally the result of the application of

force while the leg is flexed.   Three or four cases of this injury are upon
record, and of these, two were the result of the knees of dragoons striking
each other while charging in sham fights ; while a third also happened to
an individual on horseback.

Symptoms.—When lateral luxation of the patella occurs, there will be
increased width of the joint and a change in its natural contour ; a want of
the normal prominence of the patella, and an abnormal prominence on one
side or the other caused by the exposed position of the condyle.  There can,
therefore, be little difficulty in recognizing the character of the accident.
The pain caused by it is extreme, and great swelling due to serous effusion
within the joint rapidly occurs.

Treatment.—In order successfully to accomplish the reduction of a lateral
luxation of the patella, it is necessary to attempt it while the limb is in the
extended position, when little more than judicious lateral pressure will be
necessary.    The most convenient manner of effecting this is for the surgeon
to rest the heel of the injured limb upon his shoulder so as to flex the
thigh upon the pelvis and extend the leg upon the thigh, thus relaxing the
quadriceps femoris muscle as much as possible, and then with the pressure
of his fingers push the bone back into its place.

When the patella is rotated upon itself a case is presented which is much
more difficult to treat.   As the muscles are often spasmodically contracted,
it will be necessary to etherize the patient in order to induce their relaxa-
tion ; but when this complete relaxation is once obtained, the sudden flexion
of the limb will often cause such a strain upon the tendon as will rotate the
bone into its place.    This luxation being, however, extremely rare, the sur-
geon, fortunately, escapes its treatment ; for the difficulty of its reduction is
so great that it has been recommended to incise the ligament of the patella
in order, by its division, to facilitate the operation.    It should, therefore, be
remembered that such a measure, by opening the knee-joint, exposes to
the risk of inflammation and anchylosis, and the patient should always be
advised of this fact before it is attempted.

### ⸲ 3.—Hey's Luxation of the Knee.

In connection with luxations of the knee-joint may be mentioned an injury
usually described as Hey's Luxation, or as a subluxation of the knee-joint,
which consists essentially in a luxation of the internal semilunar cartilage.
This injury is often very difficult to recognize unless the surgeon's attention
has been specially directed to it ; the patient complaining of acute pain, and
not showing anything like marked deformity, or a tendency to displacement.

Etiology.—Wrenches of the foot are a common cause of this condition of
the knee-joint, but the injury seldom occurs except in those who, owing to
preternatural relaxation of the ligaments of the knee, especially the internal
lateral ligament, are thus predisposed to it.

Symptoms.—The symptoms are sufficiently marked ; the individual com-
plaining of intense pain in the knee, and dropping as if shot at the moment
of its occurrence.  The pain is of a sickening character, and when the patient
attempts to rise, he not only finds it much increased, but perceives a stiffness
in the limb which renders it incapable of sustaining the weight of his body.
There is, however, little or no swelling for several hours after the injury ; so
much so that but for the difficulty of motion, and the inability to sustain the
weight of the body upon the limb, it might be supposed that the injury was
nothing more than a sprain.  On examining the joint carefully, however, the
displaced cartilage can generally be felt making a slight prominence under

the skin on the inner edge of the knee—provided swelling has not super-
vened.

**Treatment.**—The treatment is simple, and may be practiced in most cases
of painful sprains of the knee which are at all obscure in their character, as
it can do no harm if a sprain only is present, while if displacement of the semi-
lunar cartilage exists alone, or complicates the sprain, the relief will be great
and instantaneous.    The success of the manipulation depends upon the fact
that the position of the internal semilunar cartilage is relaxed when the limb
is flexed, and consists in the following efforts : Seat the patient upon the
edge of a high table or bed, and, stooping before him, manipulate with the
limb gently while his attention is engaged in conversation.    When at last
he is off his guard, flex the limb suddenly under the edge of the table or bed
on which he is seated, and the cartilage will generally slip into its place,
the pain being removed in a moment, motion restored in the joint, and the
patient rendered comparatively comfortable.    Afterward attention should
be given to the condition of the joint, the parts being kept at perfect rest,
and inflammation combated as after any other injury of this articulation.
When the patient begins to walk, he should wear an elastic bandage around
his knee, in order to impart additional strength to the articulation.

When this slipping of the cartilage results, as is sometimes the case, from
debility and relaxation of the ligaments, a plan of treatment becomes neces-
sary which in principle and practice is precisely that which is required in
subluxations of the jaw, consisting in douches, cold baths, blisters, etc. as
local measures, accompanied by the use of such means as will improve the
general health.

### ₰ 4.—**Luxation of the Fibula.**

A luxation of the fibula alone may occur at either extremity of the bone,
though it is a very rare event.

**Symptoms.**—The symptoms are easily recognized, and the luxation, as a
general rule, can be readily reduced, after which the parts should be kept at
rest until the ruptured ligaments have united.

## SECTION III.

### LUXATION OF THE ANKLE-JOINT.

**Anatomical Relations.**—The ankle-joint consists of the articulation of
the tibia and fibula with the astragalus, and is naturally a strong joint, the
prominent malleoli guarding against lateral luxation, and being aided by
powerful external and internal lateral ligaments ; and although the capsular
ligament anteriorly and posteriorly is extremely imperfect, yet this joint is
strengthened by the extensor tendons in front, and by the tendo-Achillis
behind.

**Varieties.**—Luxations of the ankle-joint may happen in four different
directions :—

1. Luxation of the bones of the leg inwardly, which is the luxation pre-
viously referred to as occurring when there is fracture of the lower fifth of
the fibula ; many denying that this luxation can occur without being com-
bined with this fracture.

2. Luxation of the bones of the leg outward.

3. Luxation of the tibia forward, so that it rests upon the astragalus
anteriorly to its articulating face.

4. Luxation of both bones backward upon the os calcis, posterior to its articulation with the astragalus. Besides which there is a partial luxation backward, in which the bones rest posteriorly to the articulating face of the astragalus, but still upon that bone

### ¿ 1.—Luxation of both Bones of the Leg inward at the Ankle.

The luxation in which the two bones of the leg go **inward**, accompanied with fracture of the lower fifth of the fibula, is the most common of these luxations. The causes are similar to those that will produce fracture of the fibula, which may or may not accompany the accident, though it usually does do so.

**Treatment.**—The treatment consists in making extension at the foot and counter-extension at the leg, while, at the same time, force is applied laterally to bring the tibia into its place, the limb being afterward kept at rest and the inflammation of the ankle-joint actively combated.

### ¿ 2.—Luxation of both Bones of the Leg outward.

The luxation of both bones of the leg **outward** is very rare. When it occurs it is usually combined with fracture of the internal malleolus or of the astragalus, but not invariably. It is to be reduced upon the same principles as the luxation inward, but the force employed to accomplish the reduction must of course be applied in an opposite direction.

### ¿ 3.—Luxation of both Bones of the Leg forward on the Ankle.

The luxation **forward** of both bones of the leg, it is said, always requires that the fibula should be broken, and is, therefore, rather a luxation of the tibia alone, the front of the capsular ligament being ruptured when the luxation occurs.

**Symptoms.**—There is more or less shortening of the foot, elongation of the heel, and prominence on the front of the ankle caused by the presence of the two bones of the leg in their unnatural position. It is to be reduced by extending the foot.

### ¿ 4.—Luxation of the Leg backward at the Ankle.

**Symptoms.**—The symptoms of luxation of both bones of the leg **backward** are precisely the reverse of those just stated; thus, there is more or less apparent elongation of the foot and shortening of the heel, the tendo-Achillis being put upon the stretch, and a prominence formed posteriorly by the position of the two bones.

**Diagnosis.**—In either of these luxations the diagnosis is easy.

**Treatment of Luxations at the Ankle-Joint.**—The *treatment* of the luxation **forward** consists in the application of strong extension and counter-extension to overcome the contraction of the gastrocnemius and soleus, as exerted through the tendo-Achillis, and while this is kept up the foot is to be strongly extended, which will cause the bones to slip into their proper position.

In the treatment of the luxation of both bones **backward**, extension and counter-extension must be made, and force applied in a direction precisely

opposite to that in which it was applied in the last case, after which the limb should be placed in a fracture-box, kept at perfect rest, dressed with cold water cloths, and every means employed which will tend to combat the inflammation of the ankle-joint that necessarily supervenes.

### § 5.—Luxations of the Astragalus.

**Anatomical Relations.**—The astragalus articulates below with the os calcis, and anteriorly with the scaphoïdes, being bound strongly to these bones as well as to the cuboïdes and os calcis by stout ligaments. Nevertheless, luxation of the astragalus alone is an accident which sometimes occurs, and is described as being possible in four different directions—forward, backward, and to either side.

**Symptoms.**—This accident is generally easily recognizable before swelling comes on, as the bone can be readily felt, and even seen in its new position; but generally a degree of swelling is rapidly developed, which materially obscures the character of the injury.

**Treatment.**—The treatment consists in attempts to force the astragalus back into its position, which, if judiciously made, will sometimes be successful, after which the strictest antiphlogistic measures, with the use of a fracture-box, must be persevered in for some time.

### § 6.—Compound Luxations of the Ankle-Joint.

**Compound Luxations of the Ankle-Joint** sometimes occur, the injury being always most serious, and ofter requiring an amputation. Such success, however, has followed the extirpation of the displaced bone in these cases of compound luxation that it will generally be advisable to attempt this operation before resorting to amputation, for if hectic fever supervenes upon the suppuration which follows the operation, the surgeon cau then amputate with quite as good chances of relief, and with as much safety to the patient, as if he had performed the operation in the first place.

Fig. 348.
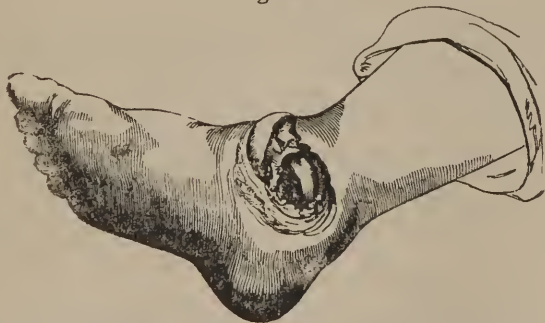


The appearance of the parts in a Compound Luxation of the Astragalus.

Cases of simple luxation of the astragalus sometimes resist every attempt at reduction until after the division of the tendons, etc. by subcutaneous section with a tenotome. This fact should be borne in mind in obstinate cases; but, when this measure fails, the parts should be kept at rest and anchylosis permitted to occur, as it is not considered good surgery to make a compound out of a simple luxation by dividing the parts from without inward, so as to expose a joint to the action of the atmosphere.

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# PART IX.

## DISEASES AND INJURIES OF THE JOINTS.

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The injuries and diseases involving the articulations, in addition to those of luxations, are sprains, arthritis and its results, morbus coxarius, false cartilages, and anchylosis, each of which must be separately studied.

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## CHAPTER I.

### SPRAINS.

A **Sprain** or **Strain** is an injury of an articulation that creates more or less contusion, stretching, laceration, and subsequent inflammatory action in the joint and the surrounding structures. It differs from a luxation in the less serious character of the laceration of the ligaments, and in not being accompanied by any displacement of the articulating surfaces of the bones that compose the joint.

**Seat.**—The articulations most exposed to this injury are the ginglymoid, in which the normal motion is more or less restricted by the firm attachment of the ligaments. Hence sprains are most commonly noticed in the articulations of the fingers, wrist, elbow, foot, ankle, and knee ; the hip and shoulder joints, being orbicular and calculated for free motion, suffering much less frequently.

**Etiology.**—The exciting causes of sprains may be either sudden muscular action or mechanical violence, the effect being dependent, in a great degree, on the violence of the movement, which, if carried very far, may, as in the ankle and wrist joints, be complicated either with a fracture of the lower end of the fibula or of the radius, these bones by their position offering considerable resistance to a sudden lateral movement of the articulation. The predisposing causes of sprains are to be found in scrofulous or rheumatic patients, in consequence of the swelling of the joints having induced a change in the normal condition of the ligaments, or in those naturally " loose-jointed," and with a peculiar condition of the articulating surfaces, as in the flat-footed, where the natural relations of the articulating surfaces are changed, or in those predisposed to club-foot, in which

the foot is constantly inclined to one side or the other by muscular con-
traction.

**Symptoms.**—The symptoms of a sprain vary somewhat, in accordance
with the violence that creates the injury. In the slighter forms there is
usually a degree of pain that differs in proportion to the contusion or lacera-
tion of the filaments or branches of the nerves, which in this variety is
slight, but in the more marked form is sometimes so violent as to induce
fainting. This pain is sooner or later followed by evidence of inflammatory
action, the intensity and duration of which also depend on the extent of the
injury. If the sprain has merely contused the areolar tissue, ruptured the
superficial vessels, and stretched the bursa mucosa in which the tendons
play over the joint, there will usually be swelling, ecchymosis, and pain
on pressure or marked motion of the joint, these symptoms being most
evident a few, or even twenty-four hours after the injury, and disappearing
after rest of the joint for a longer or shorter period, say forty-eight hours.

But in the more common and marked varieties, the pain is severe at
the moment, the slightest effort at motion greatly augmenting the suffer-
ing, the patient being unable to sustain any weight, or even allow the
hand, if the injury is in the wrist, to hang without support. As inflamma-
tion is developed, the swelling and heat around the joint become marked,
the pain is augmented, motion causes intense suffering, and the usefulness
of the limb is entirely destroyed for the time. After a few hours there will
also be noted the evidence of acute arthritis, as shown in serous formations
in the bursa mucosa, and in the cavity of the articulation, the swelling
in the latter case being restricted to the boundaries of the synovial mem-
brane. On the second, or even the fourth day, the swelling continuing,
there will also be more or less induration around the joint from formation
of fibrin, the skin, especially around the joint and in the line of the muscles
that have been most stretched, taking on the varied hues caused by ecchy-
mosis from other causes.

In chronic sprains, the symptoms above detailed are usually absent, but
we have those of chronic inflammatory action, as shown by the induration
of the areolar tissue and bursæ from the exuded fibrin, by adhesion from
bands of lymph in the bursa preventing the play of the tendons through
them and between the surfaces of the synovial capsule, thus constituting
false anchylosis, while we may also note a loss of motion due to the
mechanical opposition of the tegumentary and ligamentous coverings of
the joint from the fibrinous deposit, as well as the formation of false mem-
brane. Should this fibrinous formation become organized, the indura-
tion and loss of motion in the joint may be permanent, while if the
inflammation involves the interior of the articulation it may result in sup-
puration, and in patients of a tuberculous diathesis develop ostitis and
enlargement of the bones with subsequent caries, or form permanent fusion
of the articulating surfaces and induce true anchylosis.

**Diagnosis.**—In making an examination of a case of sprain, it should
be borne in mind that, owing to the change in the shape of the joint,
sprains may be confounded with luxations, particularly in the case of the
wrist and knee joint. A sprain may also be mistaken for a fracture, and
*vice versa.* Thus, a sprain of the wrist, with more or less effusion into the
bursa surrounding the flexor tendons, may produce a marked swelling on the
front of the hand, with pain and loss of motion that might be mistaken for
Barton's fracture. On the other hand, every sprain in the neighborhood of
the wrist or ankle should be carefully examined lest fracture coexist.

On account of the manner in which the flexor and extensor tendons of
the hand are surrounded by bursæ in the neighborhood of the wrist, such a

sprain as produces effusions into these bursæ may be followed by inflammation of the bursa itself, and thus develop a tumor or swelling that from its density and hardness may be mistaken for a displaced bone, as in the bursal swelling near the wrist-joint, called "ganglion," which might be confounded with a luxated carpal bone, or in the tarsus with a similar displacement of some of the bones of this articulation.

The rapidity with which effusions into these bursæ occasionally occur deserves notice, they being sometimes seen within ten minutes after the accident, the swelling having taken place to such an extent as to form a tumor of considerable size before the surgeon is called to the case. Usually fifteen to twenty minutes is sufficient to produce a well-marked deformity, which, however, can be readily distinguished by careful examination from fracture or luxation. In the examination of a sprain, the surgeon should not allow the pain given by his manipulations to deter him from thoroughly learning the condition of the parts; and if the patient is unable to bear the suffering, he should be etherized, as it is of the greatest importance that the precise nature of the case should be understood. The fracture most likely to be confounded with a sprain of the ankle-joint is that of the lower fifth of the fibula, the possibility of which should always be recollected when examining the ankle-joint after a sprain, while Barton's fracture, as before stated, is frequently conjoined with a sprain of the wrist.

**Prognosis.**—The prognosis of a sprain depends very much upon the extent of the injury, upon the constitution of the patient, and upon the promptness and activity of the treatment. When the injury is of the milder variety—that is, limited to the tissues mainly exterior to the joint, as the areolar tissue, veins and smaller nerves, the bursæ mucosæ, tendons and muscles, with mere stretching of the ligamentous fibres at some one point—the prognosis is more favorable than in the more severe laceration, and seldom requires more than two weeks' attention, with an appropriate antiphlogistic treatment. If untreated or injudiciously treated while motion of the joint is persevered in, this favorable prognosis will be materially modified, as any sprain, even when slight, is liable to be followed by arthritic inflammation and its consequences. In a gouty or scrofulous diathesis even a slight sprain will suffice to develop subsequent arthritis. In the more severe form the injury is much more serious, and the prognosis should be guarded, the injury sometimes demanding weeks of treatment. In chronic sprains, months or years may be required, especially when the patient continues to use the joint, inflammation in these cases being liable to develop suppuration within the joint, caries of the bones, and eventually lead to amputation of the limb in order to save life. In every severe acute sprain the patient should, therefore, be made to realize the fact that the injury will probably require as long a period for its cure as a fracture, and that rheumatic pains in the part may perhaps trouble him for many months subsequently, especially on the occurrence of damp weather.

**Treatment.**—The treatment of a sprain will vary in accordance with the condition of the part, and may be classified as that appropriate to the *simple*, *severe*, and *chronic* variety, to the first forty-eight hours after the injury, to the acute inflammatory stage, and to the chronic variety.

In the simpler variety of sprain, especially when the patient is promptly seen, the first indication is to prevent the development of inflammatory action and check vascular congestion. This may be promptly and certainly accomplished by thrusting the leg or arm (sprain of ankle or wrist) into a vessel of cool water, and renewing the water as soon as it becomes warm. If the patient is a female, and not menstruating or suffering from catarrh, nor of a

gouty diathesis, the limb should be kept in for about one hour, and then surrounded by cloths constantly wet, so as to prevent any elevation of temperature, the joint being maintained at perfect rest for forty-eight hours. Irrigation, well and methodically applied, will answer the same purpose, but is not so readily obtained, nor so apt to be judiciously employed by the patient, any one readily employing properly the cold local bath. If the immersion causes increased pain, the patient should yet be encouraged to persevere, as a half hour usually suffices to produce such sedation as gives perfect relief, and induces him to persevere for hours. When removed from the bath, the part is usually cold and devoid of sensibility. The temperature of 53° F. is sufficiently low for most cases. To insure rest of the articulation, after removing it from the bath it should be well wrapped in cloths by figure of 8 turns, and then kept constantly wet, so that there may be no sensation of heat in the part, while at the same time there should not be such cold created (as by use of ice) as would expose to the risk of mortification. After twenty-four hours the moisture of the cloths may gradually be diminished, and if the part is painless, gentle use of it be attempted, but if painful, the cold cloths should be continued. Under this treatment the recovery of a sprain is often prompt, and much more so than when warmth is applied.

In the severe and more common variety of sprain it is difficult to prevent subsequent inflammatory action, and as the pain of the cold immersion is often such that the patient is unwilling to submit to it, I seldom attempt the treatment by cold in this variety, but proceed at once to check the local congestion by directing, at the period when the patient is first seen—that is, within twenty-four hours after the injury—the *free* abstraction of blood by leeches, thus emptying the engorged vessels, favoring the absorption of the effused blood, and hastening the absorbent action of the inflamed areolar tissue. Then surrounding the joint with flannels wrung out of *hot* water, as hot as can be borne, and covering them with oiled silk, fasten them to the part with a handkerchief bandage, and elevating the limb on an inclined plane, keep it elevated for days, or while the acute stage lasts, the cloths being changed every two hours during the day, and well wrung from the hottest water.

In sprains of the ankle, rest may be best insured by the use of a fracture-box, as in fracture of the leg, while a carved splint or one of wire, gutta-percha, plaster of Paris, starch, or some similar substance, answers for other joints. When, after the lapse of some days, say fourteen, the swelling and tenderness have abated, gentle frictions with anodyne liniments may be resorted to, and *gentle* pressure applied by means of numerous turns, in figure of 8, of a flannel roller. When thickening and stiffness of the joint remain, as about the twentieth day, the cold douche for a few minutes, followed by friction with soap liniment for a half hour, and passive motion for a few minutes, together with the perfect rest of the joint for the ensuing twenty-four hours, is useful, the patient not being allowed to use the joint as long as firm pressure on the part causes pain ; subsequently, he may gradually commence its use.

In the *chronic* sprain, there is usually either a subacute arthritis or a thickening of the ligaments and surrounding bursa and areolar tissue that renders the first attempts at the use of the articulation quite painful and difficult. The indications here are the same as in chronic inflammations of other parts, to wit : to modify the local circulation, favor the absorption of effusion, and restore the natural function. The means of accomplishing this will depend greatly on the condition of the part. If the inflammatory action is evidently deep seated, as shown by the pain on motion and the synovial tumefaction, stimulants to the surface will be useful, provided they are so employed as not to develop

too much irritation.   These stimulants of the superficial circulation are to be found in the application of the cold douche and friction, in surrounding the joint once every twenty-four hours with cloths wrung out of the coldest water, covering them to prevent evaporation, and retaining them until free sweating is induced, as in the packing of the hydropathic applications.  Or if this is not convenient, a gentle blister, or one maintained only so long as to redden the skin thoroughly, repeated when the effect has subsided, will often prove serviceable.  If applied for a longer time and repeated, the blister has, in some instances, developed so much action as to create abscesses and ulceration of the integuments.    Painting the surface of the skin over the joint daily with the tincture of iodine acts on the same principle; and I have seen benefit from a poultice of guano, a dirty and offensive application, but sometimes the most readily obtainable.

Lately, the stimulating effect of the actual cautery, applied as a counterirritant, has been highly lauded; but it possesses no advantage over other stimulants, is apparently harsh and barbarous, and, in the estimation of many, degrades the surgeon to the position held by the barber-surgeons of an early period.  If the hot iron possessed peculiar virtues, this might be overlooked; but as it does not, acting only as a local irritant, the revival of the harsh practice of an ignorant and uncultivated period in surgery deserves reprobation. When passive motion does not develop symptoms of acute inflammation, it should be persevered in, many cases being benefited by such motion as overcomes the adhesions and thickening of the parts surrounding the articulation.    But when motion is constantly painful, when increased heat supervenes on its employment, or when the swelling is reproduced, absolute rest is essential to prevent the development of such inflammatory action as will end in suppuration within the joint, ulceration of the cartilages, or caries of the bones.  At the same time, the patient's general health should be improved by out-door exercise, without using the injured joint; by the administration of chalybeates, bitter tonics, full diet, etc.; very many of these obstinate cases of chronic sprain being due to the tuberculous diathesis of the patient.

When acute inflammation attacks the indurated tissues around a sprained joint, suppuration and sinuous ulcers may be established, hectic induced, and amputation demanded in order to save life, a result occasionally met with.

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# CHAPTER  II.

## ARTHRITIS, OR INFLAMMATION OF THE JOINTS.

**Arthritis**, or inflammation of a joint, is a disorder that, in connection with its development in a rheumatic or gouty diathesis, comes specially under the notice of the physician.  That which ensues upon wounds involving the articulation, or as the result of compound fractures and luxations, has been already alluded to.   It remains, therefore, only to notice the variety seen in connection with the wrist, elbow, and knee joints directly consequent on an injury in a patient of the tuberculous diathesis, though sometimes this disorder will be seen without our being able to trace it to any cause that can be recalled by the sufferer.   As arthritis is not an inflammation of the synovial membrane alone, the term synovitis would often be inapplicable to it, while the old term "white swelling," in connection with its seat in certain joints,

being indicative only of the appearance of the external tumefaction, expresses little that points out the true condition of the parts affected.    Arthritis may be either acute or chronic.

# SECTION I.

### ACUTE ARTHRITIS.

By **Acute Arthritis** is meant any acute inflammation of a joint and its adjacent structures, attended by the changes characteristic of acute inflammation of other parts, though here modified by the structures involved.

**Pathology.**—Acute arthritis may present any of the evidences of inflammatory action, from the simplest degree of vascular congestion of the articular covering and membranes, to the termination, by suppuration and necrosis or death, of the bony surfaces involved.   In this extended range, we may note all the productions and increased cell action usual in inflammation, as that of serum, of fibrin, and of pus, with the soft tumefaction of edema, the firmer swelling of plastic lymph, and the fluctuation of serum (dropsy) in a closed cavity, or that of pus under similar circumstances, this ultimately changing the articulating cartilages, ligaments, and periosteum.

**Symptoms.**—The symptoms of acute arthritis vary in accordance with the intensity of the inflammation and the character of the joint affected ; but a greater or less degree of *pain*, with restricted motion and tumefaction, is attendant upon it under most circumstances.

Usually the pain is intense, and the slightest attempt at motion excruciating, while sometimes any, even the slightest movement, is absolutely impossible.   The *swelling* of the joint is always more or less marked, being sometimes due to serous effusion into the synovial capsule, and restricted by its reflections, a stage often designated as synovitis, and hereafter described, or being, in consequence of the infiltration of the adjacent areolar tissue and the effusions into the bursa and tendinous sheaths near the joint, more expanded.

When the tumefaction is due to fibrinous deposits, the swelling is firmer and more resisting, as well as more permanent, than that due to serum or pus.   The *redness* of the parts around a joint attacked with acute arthritis is often at first very marked, especially when the inflammation has traveled to the integuments, while at other times the vascularity of the skin is much impaired, the joint being of a white, doughy appearance, and presenting the condition formerly known as "white swelling."   The *heat* is usually much above the normal standard, abating as the inflammatory action ceases.

**Diagnosis.**—The locality and character of the pain, together with the heat and tumefaction, usually render the diagnosis easy.

**Prognosis.**—The prognosis of acute arthritis depends greatly on the cause and extent of the inflammation and the habits and diathesis of the patient. The more acute the inflammation and the greater the swelling, the more serious should be the prognosis, as the result may be the destruction of the joint or the development of hectic fever, and the death of the patient.   When the effusion is limited to serum, the prognosis is more favorable than when lymph has become organized, this tending to the development of adhesions and the creation of the condition known as "false anchylosis," as hereafter explained.   In the event of suppuration and the evacuation of the pus by ulceration of the integuments, death may ensue from hectic, or the limb may demand amputation or resection of the joint, or the disease may result in fusion of the articulating surfaces of the bones and "true anchylosis."

**Treatment.**—The treatment of acute arthritis must be both local and general.

The local treatment consists in the free application of leeches around the inflamed part, followed by warm fomentations, and the most absolute rest of the joint until the pain from motion has passed away, combined with the use of such local means as were advised in the treatment of acute sprains. Position and rest are especially important in the treatment of acute arthritis. If the position is not one that will induce the utmost relaxation of the ligaments forming the articulation, it will prove injurious, and keep up the congestion, but when the position induces this relaxation, and is combined with rest, it constitutes a most valuable portion of the local treatment, especially in arthritis of the hip, knee, and elbow joints.

The constitutional treatment of acute arthritis is that applicable to acute rheumatism or gout.

## SECTION II.

### SYNOVITIS.

When the serous membrane that lines an articulation is alone inflamed, it constitutes a special form of arthritis usually designated as **Synovitis**, and when, as the result of this inflammatory action, there is a marked increase of the secretion of the membrane, more or less mixed with true serum, it constitutes the **Hydrarthrosis** (or **Dropsy of the Joint**) of many writers.

**Synovitis** may ensue upon any cause that will develop inflammation, and is followed by the ordinary effects of inflammation in other serous tissues, the serous accumulation resembling serum from other sources, it being a clear, transparent, straw-colored liquid, that coagulates like all albuminous solutions, and differs from the synovial fluid in not being viscid or adherent to the finger. Like other serous inflammations, synovitis is most apt to create a free secretion of serum when the inflammation is of a chronic character, and in most cases post-mortem examination shows vascular injection, false membrane, and a serous liquid.

**Symptoms.**—In an attack of acute synovitis each joint assumes a characteristic position. By a series of experiments upon the dead subject, Bonnet, of Lyons, found that this position corresponded with that which allowed the greatest possible distention of the cavity of the joint. In the knee, it is that of semi-flexion at an angle of about 120°, Fig. 349.

Fig. 349.



A view of the position taken by the limb in synovitis of the knee, so as to permit the greatest relaxation of the capsule of the joint. In this condition the limb is adducted—constantly flexed at the knee, and supported on the internal border of the foot. The pelvis is inclined to relieve the limb of the weight of the body. (After Bonnet.)

At the hip, the thigh is bent on the pelvis, abducted and rotated slightly

outward.   At the elbow, the forearm becomes bent at a little more than a
right angle on the arm, and the radius takes a position between pronation
and supination.   The characteristic position of the arm in cases of synovitis
of the shoulder-joint is a little away from the side, and in front of the body.

In addition to the symptoms described in connection with arthritis, syno-
vitis is characterized by a soft fluctuating swelling that is limited by the
boundaries of the synovial membrane, the fluctuation indicating the motion of
a thin liquid, while the distention of the sac impairs, in a marked degree, the
motion of the joint.

**Pathology.**—It was long thought, and the opinion has been advanced by
so late an author as Bryant, of Guy's Hospital, that the first effect of synovitis
was an arrest of the natural secretion, and a consequent dryness of the mem-
brane.   Nothing positive has, however, been advanced in favor of this view,
and it seems to be clearly disproved by the experiments of Richet, of the
Hôpital Bons-Secours, upon the lower animals.

Soon after synovitis begins, the membrane becomes reddened, but the injec-
tion seems to belong chiefly to the subserous connective tissue.   The whole
surface of the membrane, but especially the interspaces between the injected
vessels, loses its transparency, and is rendered opaque.   The infiltration causes
a thickening of the membrane, but is so intimately associated with the subse-
rous tissue as to form but one membrane.   Effusion takes place often in large
quantities ; at first the fluid is of a clear, serous character, but afterward it
becomes more fibrinous, containing flocculi floating about and adherent to
the sides of the sac.   In some cases, and especially in those of a traumatic
origin, the inflammation will proceed beyond this stage, and the fluid appear
more turbid on account of the formation of pus ; the cartilages also begin to
ulcerate.   If the inflammation continues, this ulceration soon reaches the bone ;
which then shows the evidence of caries, and abscesses are developed around
the inflamed joint.   If these parts now recover from the caries, it can only
be with firm anchylosis of the joint.*

**Diagnosis.**—The swelling, circumscribed by the lines of the joint, the sense
of fluctuation, with the history of the case, generally render the diagnosis of
synovitis easy.

**Prognosis.**—The prognosis depends very much on the joint affected, and
the acute or chronic character of the inflammation.

If appropriately treated, simple synovitis will disappear in most cases with-
out seriously involving the articulation, provided false anchylosis is guarded
against.   But as synovitis is generally complicated with arthritis, or inflam-
mation of the other tissues around the articulation, and may be followed by
serious changes in the joint proper, the prognosis should be guarded.   If
the patient has good health, the prognosis will be favorable ; but if of the
tuberculous diathesis, the prognosis will be more unfavorable, this condition
being liable to be followed by other diseases of the articulation.   In chronic
arthritis with free serous accumulation, (dropsy of the joint,) the prognosis
depends chiefly on the freedom of the articulation from other diseases.

**Treatment.**—As the prognosis of synovitis is serious or otherwise in ac-
cordance with the general health of the patient, the constitutional treament
is of the first importance, and should be such as will modify the perform-
ance of the functions of the body.   Hence purging by saline cathartics, the
administration of diuretics, and the appropriate use of chalybeates may be
required.

The local treatment must vary in accordance with the acute or chronic
character of the complaint, both conditions being amenable to the general

* Rokitansky, Barwell, and Bryant, loc. citat.

principles already given of acute and chronic inflammation; that is, antiphlogistic in the acute, and more stimulating in the chronic variety, as previously alluded to in connection with sprains. When dropsy of the joint supervenes, the absorption of the serum may be accelerated by judicious compression by adhesive strips, or a bandage, with moderate exercise of the joint—that is, such passive motion as can be employed without creating pain—or by the use of local stimulants, especially flying or oft-repeated blisters, as before described.

The use of the cold douche and of light cauterization will, in the chronic form of synovitis, as in that of sprains, also sometimes prove highly beneficial. In chronic synovitis, resulting in dropsy of the joint, it has been recommended to treat the case as one of hydrocele; that is, to evacuate the liquid with a trocar and canula, and inject iodine into the joint to modify the action of the serous membrane, care being taken not to admit the atmosphere, and to combat violent inflammation, when it supervenes. After being laid aside for many years by the profession, this practice has been lauded by Velpeau and Bonnet in France, and by various English and American surgeons, who have repeatedly practiced it with success. Gay, of Cape of Good Hope Hospital, in 1789 successfully practiced this operation, injecting the diacetate of lead in solution. In 1841 Bonnet and Velpeau, in France, injected iodine as stated. The mixture commonly employed is one or two drachms of Lugol's solution to the ounce of water—a trocar and canula being plunged into the joint at some suitable spot, as above and outside the patella at the knee, and above the internal condyle at the elbow, the trocar being passed obliquely, so that the opening may be valvular. On withdrawing the trocar the serous fluid is allowed to flow out, the joint being slightly compressed by the finger, but its cavity is not to be emptied. A syringe perfectly adapted to the canula is then to throw in the liquid, and the finger being placed on the orifice of the canula as soon as the syringe is removed, move the limb up and down without bending or straightening the joint, except slightly, so that the fluid may come in contact with every portion of the synovial membrane. Then, after the lapse of one minute, place the limb so that the solution may run out of the canula, applying slight pressure to favor its egress, withdraw the canula, and close the puncture with a piece of diachylon.*

It has been shown by these surgeons that five out of eight cases have been cured—three out of five being promptly relieved without any accessory treatment.† But as much depends on the caution shown in the operation in excluding the atmosphere, and selecting proper cases of chronic and pure synovitis, the operation should not be performed until all other means have failed, and the dropsy of the joint is marked. Lugol's solution, and not the tincture of iodine, should be employed for the injection, as the latter coagulates the albumen, though Velpeau has often employed the tincture diluted with two or three times its bulk of water.

It has been proposed by Goyraud to make a *subcutaneous section of the synovial membrane*, and then apply pressure with the view of obtaining a permanent cure. This plan, taken in connection with a case related by Bonnet, in which a fall ruptured the membrane, and a cure resulted, is certainly deserving of attention.‡

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* Barwell on the Joints. Phila. edit. p. 206
† Op. citat. ‡ Barwell, pp. 204, 205.

## SECTION III.

### CHRONIC ARTHRITIS.

When, as the result of **Acute Arthritis**, fibrin is poured out into the sur- rounding areolar tissue, or between adjacent synovial surfaces, so as to induce destructive modification of tissue, it creates a tumefaction and change of function that is often most serious, and worthy of careful study; the utility of the limb being dependent on a correct appreciation by the practitioner of the pathology of this disorder. In order to render this more apparent, the reader should recall the structure of the joint : 1. That the articulating surfaces of the bones are covered by articulating cartilages that derive their sustenance by absorption from the subjacent bone and its blood-vessels. 2. That the synovial sac is a serous membrane liable to the pathological changes of serous tissue elsewhere. 3. That the ligaments present the peculiarities of fibrous tissue. 4. That exterior to the ligaments of the joints mainly affected by chronic arthritis we have fibrous expansions in tendons and bursæ mucosæ, in which the tendons play. 5. That exterior to these is an amount of free connective and areolar tissue with the aponeuroses of the limbs and the tegumentary covering. With such a varied mechanism and variety of tissue it may naturally be inferred that chronic arthritis will present very varied conditions—all, however, referable to the effects of chronic inflammation— that is, one supervening on acute inflammation of similar tissues elsewhere.

**Pathology.**—The conditions seen in chronic arthritis vary greatly, but mainly in proportion to the extent and violence of the acute inflammation that has preceded the chronic stage. Sometimes we note only the changes characteristic of recently produced and non-organized fibrin on serous tissues ; again, it may be semi-organized, as in false membrane, being attended by serous infiltration of the cavity and adhesions with thickening of the affected tissue, while exterior to the joint we may have an organized or organizable fibrinous deposit that will create a pultaceous condition of the areolar tis- sue, with thickening of fascia, etc., or develop "false cartilages."

When the inflammatory action has been more marked, external or internal suppuration of the joint may be noted, accompanied by ulceration and bur- rowing of pus, or followed by softening and destruction of the articular car- tilages and ulceration of the ends of the bones. At a later period the latter may be found fused by the formation of bony granulations from the cancel- lated tissue exposed by the removal of the articular cartilages, or the can- cellated structure may become covered with a layer of compact bone, or the cancellæ solidified so as to give rise to a hard, ivory-like surface that friction polishes, thus creating the condition known as **"eburnation."** At other times the extension of the inflammatory action to the periosteum covering the end of the bone near the articular cartilages results in increased nutritive action, and the formation of new bony growths of a regular or irregular character, as is frequently seen in connection with chronic arthritis of the hip-joint.

**Etiology.**—The causes of chronic arthritis, like those of the acute class, are varied. Unless in a rheumatic, gouty, or tubercular diathesis, chronic arthritis is usually not developed, except by repeated attacks of acute inflam- mation, or one badly treated. In every instance it is the result either of an acute or subacute inflammation that has been unchecked by appropriate treat- ment, or kept up by repeated injuries.

**Symptoms.**—The symptoms of chronic arthritis are, therefore, only a diminished degree of those seen in acute arthritis as respects the redness,

heat, and pain, with a more dense and permanent swelling, and the changes of structure due to a modified nutrition in the tissues affected. Hence we often find in chronic arthritis new osseous developments, or cartilaginous growths, that are spoken of as false or movable cartilages, or foreign bodies in joints.

When chronic arthritis is met with in the tubercular diathesis, it may, like pneumonia, be the exciting cause of tubercular deposit in the bones, and thus develop the symptoms already described as those of tubercles in the bones near the articulation; or the progressive destruction of the tubercles in the bones may become the origin of chronic arthritis. In either of these cases we may find the symptoms attendant on enlargement of the articular bony surfaces, in addition to those due to a chronic inflammation of the peri-articular tissues.

**Prognosis.**—As the result of chronic arthritis is very varied, and its symptoms modified somewhat by the joint affected, the prognosis will also vary greatly, though the disorder must always be regarded as likely to affect seriously the usefulness of the articulation, and to require a long-continued treatment. In a restricted inflammation, and a healthy constitution, the joint will often be restored to perfect usefulness; but in very many instances, and especially in patients with the tubercular diathesis, a marked modification of usefulness may be expected, if an operation is not demanded in order to save life. Without, then, dealing in generalities, it will prove most useful to consider the subject of arthritis in its acute or chronic form in two of the joints where it is frequently seen, and where the result of the disorder is most marked; the general principles alluded to in these localities being equally applicable to the disorder when seated in the wrist, elbow, shoulder, or ankle joints.

As developed in the knee, the varied changes dependent on arthritis, especially in tuberculous patients, has been long known as "White Swelling;" while in the hip-joint it is specially designated as Morbus Coxarius, or Coxalgia, and to these attention may now be given.

## § 1.—White Swelling.

**Symptoms.** — In the peculiar form of arthritis met with in the knee-joint, and designated as **White Swelling**, we find the symptoms are as follows : The patient first notices a certain degree of tenderness about the articulation, which, gradually developing with the disorder, often causes marked tumefaction and pain of a varied degree and duration, this being followed by stiffness of the joint, and more or less loss of its proper motions. When the swollen joint is now handled, no sense of fluctuation is communicated to the touch, but a peculiar sensation is perceived, which indicates the presence of a thick gelatinous substance beneath the skin, this substance presenting a soft, pultaceous mass, which yields somewhat to pressure, but does not permit the skin to pit, as in edema, unless accompanied with inflammation of the integuments. The tumefied joint is also usually whitish or pearlish in its color, and there is no enlargement of the superficial vessels, with no pinkish hue, as in the tumefaction of joints due to acute arthritis, rheumatism, or gout.

The disease progressing, the parts become hot, the skin distended and shining, and then a slight vascular congestion may be noticed, which gives a pinkish or purplish tinge to the tumor. By-and-by ulcerations communicating with the joint are developed in the skin, and through these there is discharged a thin, bloody ichor; symptoms of hectic are now developed, if

not previously present, and the patient becomes prostrated by colliquative sweats and diarrhœa, presenting not unfrequently evidences of thoracic disease, till finally death closes the scene. Or, a more favorable change taking place, the patient survives the exhaustion of the suppuration, and gets well with anchylosis of the joint in a deformed position.

Throughout the course of the complaint it should be remembered that there is no distinct sense of fluctuation around the joint, as there is in synovitis; the disease consisting rather in a chronic inflammation and effusion into the areolar tissue, and beneath the ligaments surrounding the joint, than in the serous tissue, though sometimes the symptoms of synovitis may be superadded.

**Pathological Condition.**—In dissections made after death or amputation, the following pathological changes have been observed: The areolar tissue exterior to the joint is thickened in a marked manner, and infiltrated with a thick, jelly-like substance, producing the condition which the French have designated as "fongosité," a term by which they do not mean to indicate anything malignant, but simply to intimate the character of its structure. In the latter stage of the disease not only is the capsular ligament thickened, but its tissue is softened, and between that part of the ligament which is lined by the synovial tissue and the ligament a pale-yellow, semi-transparent matter is deposited, which is several lines in thickness, without blood-vessels, and evidently due to effusions of plasma of an unorganizable character. By similar effusions partially organized, if the disease is of long standing, the ligaments, tendons, and muscles surrounding the articulation are glued together, producing a considerable amount of false anchylosis; while if the inflammatory action continues, the disease may extend itself to the cartilages, or to the bones themselves, producing ulceration of the cartilages, with caries or necrosis of the articulating extremities of the bones.

**Diagnosis.**—To arrive at an accurate diagnosis in white swelling it is only necessary to bear in mind the symptoms of chronic arthritis, conjoined with the tuberculous appearance of the patient, the fact that the disease was developed without any marked injury, the patient being unable to account for its production, or assigning it to trifling causes; then that in its earlier stages at least it is combined with no marked signs of inflammation; and lastly, that there is no marked fluctuation, as in simple synovitis, while the sense of touch gives evidence of the presence of a certain peculiar soft matter deposited beneath the skin in the connective tissue.

**Prognosis.**—The prognosis of white swelling should be guarded, the result depending, in a great measure, on the constitution of the patient, as the disorder may terminate either in death by hectic, in anchylosis, or by amputation of the limb, the patient often recovering rapidly after amputation; though sometimes exhibiting in a few months the evidences of pulmonary consumption.

**Treatment.**—The first and most important indication in the treatment of white swelling is to improve the general health, the treatment demanded in any inflammation resulting from the tuberculous diathesis or complicated with it being equally applicable to this disorder. Thus in the early stages of the local treatment much is to be expected from a judicious leeching when the joint is very hot and acutely inflamed; but when the disorder is of a more chronic character, counter-irritants, as blisters repeatedly applied in the neighborhood of the joint, or stimulating and mercurial frictions, or plasters—particularly those which combine the two characters, an excellent one being a mixture of the emplast. galbanum comp. with mercurial ointment—spread and kept constantly on the joint, will be highly serviceable.

The local use of mercurials is especially demanded when the tumefaction is evidently due to fibrinous deposit, in order to diminish the vascularity and organization of the lymph effused around the joint, by increasing the congestion of the skin.

Benefit has also resulted, in some cases, from painting the joint thoroughly with the tincture of iodine, repeating it from time to time as the stimulating effect passes off; a plan of treatment which is highly useful in inducing contraction of the tissue, as well as by stimulating the vessels of the skin to increased action.

During this treatment, the joint should be kept at perfect rest by means of a carved splint of *wood*, a felt splint, or one of gutta-percha, these being made upon the same principle as those described in connection with hip-joint disease; so that the joint may be kept at rest without the necessity of confining the patient to bed, a practice which is much to be deprecated, the confinement being badly borne by this class of patients, who need fresh air and exercise quite as much as medical treatment. In permitting a patient with white swelling to exercise, much will depend upon the means that are selected, such only being resorted to as will allow of the general movements of the body, while the affected joint is submitted merely to such passive motion as will tend to preserve a healthy circulation and obviate congestion, as riding in a vehicle with the limb carefully supported, or walking slowly with a crutch. In warm weather it will also prove useful, especially in hospitals, to have the patient's bed placed in the fresh air for a few hours each day.

Should, however, the disorder progress in spite of treatment, and hectic supervene, much may be done for the relief of the patient, without the necessity of amputation, by resorting to the operation of resection of the joint, a class of operations daily growing in favor, and by means of which many limbs have been saved that, under the old practice, would inevitably have been sacrificed by the knife of the surgeon.

When white swelling has induced marked changes in the structures of the knee, it may so impair its usefulness as to create the condition known as anchylosis.

### ¿ 2.—Anchylosis.

Under this disordered action, either within or around the joint, the limb is left entirely to the course of nature, and is most apt to be flexed or bent (αγκυλος, crooked;) hence this condition of stiffness and loss of motion in an articulation is usually designated as **Anchylosis.**

" The joint is usually flexed, because the flexor muscles are stronger than the extensor; because this position allows, during the height of the inflammation, the greatest distention of the joint; and because the flexor muscles are supplied by the same nerves as the joints, and therefore contract upon the irritation of their nervous filaments induced by the inflammation of the joint."*

**Varieties.**—Two conditions of parts are met with in stiffness of the articulations: 1. **False Anchylosis,** or immobility, caused by inflammatory action in the parts exterior to the articulation, as in the bursæ, fascia, tendons, and muscles, with some thickening of the ligaments. 2. **True Anchylosis,** due to the destruction of the interior of the joint and the bony fusion of the two articulating surfaces of the bones which compose it. Anchylosis, it will be seen, is therefore purely the result of chronic arthritis, and its results are

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* Bryant, p. 117, Lond. ed,

sometimes spoken of as *complete* and *incomplete, perfect* or *imperfect*, these terms indicating the amount of motion left in the articulation by either true or false anchylosis.

**Pathology.**—The state of the parts in **false anchylosis** presents generally a deviation from the normal condition of the ligaments, tendons, and fascia, exterior to the articulation; the ligaments being thickened, stiffened, and contracted, especially on the side of the joint which corresponds to flexion, while the tendons and fascia are similarly retracted, and thickened by fibrinous deposits, so that they cannot be readily extended, even when considerable force is used. Sometimes false anchylosis results from the formation of bands of lymph within the bursa mucosa, so as to limit the play of the tendons, and sometimes these form within the synovial capsule of the joint, where they act the part of adventitious ligaments, and limit the motion of the articulating surfaces. Sometimes a false membrane is created within the serous tissue of the joint, similar to that seen on the pleura after inflammation.

Sometimes, in **true anchylosis,** the articulating cartilages and synovial membranes having been removed by suppuration or interstitial absorption, the two bony surfaces are brought in contact and fused one upon the other; while in other cases various bony spines and processes, which often correspond with the position of the lateral ligaments, join the bones together, or limit their movements.

**Etiology.**—Various causes may create anchylosis; thus **true anchylosis** may be the result of chronic arthritis, which induces ossification of the cartilages and intervertebral substances, in the ribs and spinal columns of old persons; and sometimes it is consequent on suppurations and caries of an articulation, as is seen in white swelling and hip disease. **False anchylosis** is generally the result of inflammatory formations, which, owing to the rest of the joint and its fixed position, contract adhesions and create thickening; hence false anchylosis ensues upon sprains, synovitis, fractures in the neighborhood of joints, badly treated luxations, etc.

**Symptoms.**—Anchylosis is rendered evident by loss of motion in the articulation, this loss of motion varying in accordance with the natural action of the joint, and showing itself in a restricted degree of flexion, extension, or rotation. In false anchylosis there is usually a change in the shape of the joint, and any marked attempt at motion causes more or less marked pain. In true anchylosis there are often marks of inflammatory action around the part, with irregular enlargement of points about the articulation. If inflammatory action still exists in a joint which is partially fused by true anchylosis, the attempts at motion may also prove painful; but usually in true anchylosis, especially when chronic, attempts at motion do not develop the patient's sensibility.

**Prognosis.**—The prognosis of anchylosis is always dependent on its extent and the position in which the limb has been placed. If the anchylosis is of the false variety, it may be overcome, and the joint rendered again useful; but if it has ended in true bony union of the articulating surfaces of the bones, motion in the part cannot be restored except by the formation of a false joint by an operation. The prognosis is also influenced by the position of the limb; thus, anchylosis of the elbow-joint would give a comparatively useful limb if the forearm is flexed on the arm, while the knee-joint would be most serviceable if anchylosed in the straight position, patients being able to walk with considerable facility on a limb with a straight and stiff knee.

**Treatment.**—The treatment of anchylosis may be classified under four periods: 1, that which is proper during its formation; 2, that required for

its prevention; 3, that demanded for its removal; 4, that which is necessary in order to change the position of the joint without the destruction of its immobility, as in a resection.

1. There are many instances in which the surgeon may be glad to obtain anchylosis of a joint, this being preferable to amputation of the limb, as in caries of the carpus and tarsus, wounds involving the knee and shoulder-joints, and in compound luxations of the ankle. In all such cases the treatment—in anticipation of anchylosis—should consist in perfect rest of the joint in that position which will give the most utility to the limb, and in preventing the exhaustion of the patient's strength, the development of hectic being carefully watched.

2. The prevention of anchylosis is to be accomplished by combating every inflammation which involves an articulation, and hastening, by appropriate means, its termination in resolution, while at the same time such gentle motion should be kept up as will prevent adhesions of the adjacent tissues and stretch those which have a marked tendency to contract. The means of doing this will be alluded to hereafter.

3. After anchylosis, whether true or false, is well established, its removal may be attempted by the use of such means as will overcome the adhesions; such as stimulating and alterative frictions, especially those containing mercurial ointment; or by the use of cold water, so as to stimulate the absorbents—both of these means being specially applicable to cases of false anchylosis, while the true bony union of a joint may be overcome either by mechanical extension or by an operation.

4. The change of position in a truly anchylosed joint which has been allowed to stiffen in an inconvenient position, may be accomplished by means of a resection,* by the subcutaneous drilling of the bone in several places, and then applying sufficient force to fracture it, or by the application of such forces as will fracture the union, the case being subsequently treated as a fracture. As the means required in the treatment of the anchylosis of different joints must be varied, they may be better understood in connection with special cases, especially those of the elbow and knee joints.

**I. Anchylosis of the Elbow-Joint.**—Without recapitulating what has been mentioned in connection with anchylosis generally, attention may now be given to the treatment of **false anchylosis of the elbow-joint.**

**Condition of the Parts.**—The elbow-joint being a ginglymoid articulation, is very liable to be affected by false anchylosis, the chief adhesions being found between the coronoid process and the front of the condyles of the humerus, and as the most natural position of the upper extremity is the extended one, this joint is most frequently found to be stiffened in the straight or partially flexed position, thus rendering it useless to the patient for many purposes; because with a straight and stiff elbow a patient cannot bring the hand to the mouth, or perform many of the daily acts of life. As the tendon of the biceps passes in front of the joint and the fascia brachialis receives an expansion from the tendon, these tissues are apt to become involved in the disorder, and to be thickened and tense, while the triceps tendon is not unfrequently similarly involved behind. In false anchylosis there is, therefore, considerable adhesion of all these tissues, but often only such as may be overcome by judicious treatment. "It is very rare that the posture during an inflammatory disease of this articulation has been such that the arm is fixed in a straight position, still it is frequently so much extended as seriously to diminish the use of the hand."†

**Treatment.**—The best plan of overcoming the condition just alluded to

is to obtain the relaxation of and increased circulation in the parts by soaking the joint, for a half hour daily, in water as hot as the patient can bear, and then rubbing the part well with mercurial ointment or some stimulating liniment. Should inflammation exist, the application of leeches and poultices, or the warm water-dressing may also prove desirable. After having thus prepared the part, such mechanical means may be resorted to as will *gradually* elongate the contracted tissues and break up the fibrinous adhesions. One of the best of these is the splint shown in Fig. 350.

Fig. 350.
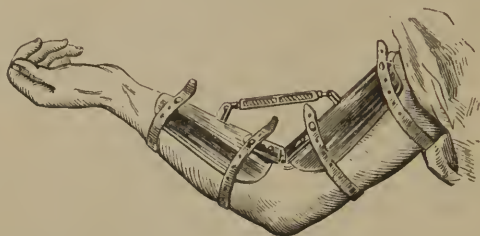


A VIEW OF KOLBÈ'S MODIFICATION OF STROMEYER'S SPLINT, AS APPLIED FOR THE RELIEF OF FALSE ANCHYLOSIS OF THE ELBOW.—This apparatus, as made by Kolbè, of Philadelphia, consists of two light pieces of wood, which are strapped around the arm and forearm, the joint being made to move by means of the screw seen on the front. Prior to its application, the arm should be bandaged, especially if much force is to be used. (After Nature.)

Tenotomy and subcutaneous division of the fascia may, under certain conditions, also prove of service in overcoming the immobility of joints.

Of late years, the operation of myotomy has had many advocates, and seems to have met with favor in cases where the patient is young. Barwell recommends that in patients under fourteen the triceps should be divided, unless the malposition be very slight, and that in adults, if the original disease had been somewhat severe, and the contraction has existed longer than six months, myotomy should also be performed if the arm is fixed at more than an angle of 120°.*

When there is much induration of tissue, the stimulus of the cold douche and passive motion, as advised in the treatment of chronic sprain, will often prove highly serviceable. Free and moderately forcible extension and flexion of the joint is often most effectual, and being widely practiced by empirics without any idea except that of brute force, has, in some instances, been very useful, and given these persons a reputation. In the hands of a scientific surgeon its utility must of course be more marked.

II. Anchylosis of the Knee-Joint.—When False Anchylosis affects the Knee-Joint, the natural position of the joint when inflamed being that of flexion, the articulation is most frequently stiffened in the flexed position, the hamstring tendons—to wit, the biceps, semimembranosus and semitendinosus—being permanently contracted, and rendered prominent behind the knee. There is also usually more or less thickening of the fascia in the popliteal space, with or without a certain amount of mobility in the patella, the latter being sometimes adherent to the femur.

Treatment.—After employing on this articulation the same general means that were stated in connection with the preliminary treatment of false anchylosis of the elbow-joint, mechanical extension of the leg may be gradually accomplished by the splint suggested by Stromeyer, or by

* Barwell, p. 384.

some of the modifications of his apparatus, such as that shown in Fig. 351.*

In the event of the adhesion of the patella to the femur being a source of difficulty, the following operation, as performed by Brainard, of Chicago, may be advantageously resorted to: In a case of anchylosis of the knee-joint of a young female aged sixteen,† in which the adhesion of the patella to the femur caused all reasonable efforts at overcoming the anchylosis by force to be unavailing, the adhesions of the patella to the femur were first overcome by the introduction of a drill (Fig. 303) through the skin, subsequently passed between the bones, and used subcutaneously as a perforator and a lever until the patella was loosened with a snap. Some ecchymosis followed, but little tenderness; ten days after the puncture was healed the patient was then again chloroformed, when the efforts at flexion were successful. An extending apparatus was then applied and gradual extension kept up. The limb was ultimately brought perfectly straight.‡

Fig. 351.



A SIDE VIEW OF KOLBÈ'S MODIFICATION OF STRO-MEYER'S SPLINT FOR THE TREATMENT OF ANCHYLOSIS OF THE KNEE.—By means of an ingenious joint to the bend of the knee, which is acted on by the key seen in the figure, Mr. Kolbè has succeeded in obtaining great power, and yet very accurately regulating its application. (After Nature.)

Barwell, of England, has substituted, in an apparatus which he recommends, an India-rubber "accumulator" in place of the screw power usually employed for breaking up adhesions. This "accumulator" consists of a band of India-rubber placed in front of the limb, and attached to a wire splint above and below the knee so as to be on the stretch. The power is thus continually employed, and if by means of a band attached to the leg the patient at times bends his leg, the India-rubber will be stretched still more, but will regain its position as soon as the band is slackened. Thus alternate flexion and extension may be obtained by an appropriate splint adapted to the affected joint. This principle of continuous extension is a very valuable one, and had been previously suggested and employed by Davis, of New York, as described in his treatment of **Hip Disease.** Barwell appears to have been ignorant of Davis's plan, or to have overlooked the suggestion.§

In case these methods do not prove effectual, the surgeon may, after having given an anæsthetic, break up the adhesions. Dieffenbach, Langenbeck, and others advocated the employment of violent and prompt force for this purpose, but it seems now generally considered that it is better to continue the gradual disruption by an appropriate splint, combining with it the division of the hamstring tendons and fascia. By some surgeons the

* These instruments can be obtained of Kolbè, surgeon's instrument maker, South Ninth Street above Chestnut. Philadelphia.
† Chicago Medical Journal for Feb. 1860.
‡ Chicago Medical Times, Feb. 1860.          § Barwell on Diseases of Joints, p. 377.

operation is finished at once, but it is preferable to allow a few days to elapse after performing tenotomy before applying any force, thus giving time for the wound to heal.

In cases of true anchylosis, Barton, of Philadelphia, has removed a wedge-shaped piece from the femur; Barwell alludes to this operation, but prefers, if the patient is under fourteen years, that the epiphysis of the tibia should be broken through.   Brainard, of Chicago, advises that the femur should be drilled in various directions, subcutaneously, and then broken so as to permit the limb to be straightened.   The selection of one plan rather than another must be decided by the peculiarities of the case to be treated.

### ? 3.—Coxalgia or Hip Disease.

Under the varied names of **Coxalgia**, **Morbus Coxarius**, and **Hip-Joint Disease**, surgical writers have, since the days of Hippocrates, Galen, and Albucasis, indicated an inflammation of this articulation that sooner or later resulted in marked changes of structure in the bony surfaces composing the joint, and involving more or less completely the destruction of its normal action.   Of these terms, the best is **Morbus Coxarius**, or **Hip Disease**, this being understood to designate a form of arthritis generally met with in tuberculous patients that is very apt to result in suppuration within the joint, softening and ulceration of the ligaments, with caries and necrosis of the bony surfaces, and luxation or anchylosis of the head of the femur.

The arthritis of the hip-joint, due to a rheumatic or gouty diathesis, presents nothing here requiring special consideration, as it differs little from what has been already said in connection with arthritis generally, except the mention of the liability of a large and freely-moving joint, like the hip, to present the changes already alluded to as the result of arthritis anywhere—that is, eburnation and exostosis, or vicious osseous formations from the extension of the inflammatory action to the periosteum adjacent to the articular surface.   But rheumatic arthritis does not constitute hip disease, the latter being always accompanied by more or less disease of the head and neck of the femur or the acetabulum, or both.

In order to render clear the causes that are concerned in producing the symptoms of hip disease, attention must be briefly given to the character of this articulation, and the changes produced in the relations of its component parts by various circumstances.   In doing this, I shall avail myself of the valuable results established by experiment, and particularly those of Bonnet, of Lyons,* although Petit, in 1722, called attention to the spontaneous luxation of the head of the femur in this disorder as explaining many of the symptoms of hip disease, and especially the flexion and shortening of the limb; and the subject has since been ably discussed by Sabatier, Boyer, Brodie, and others.   The cause and mechanism of this deformity is yet a vexed question.   It becomes therefore important, for the clear comprehension of the symptoms of hip disease, to recall the facts established by the labors of Bonnet, in his experiments upon the healthy joint, as well as to trace their connection with the symptoms and progress of diseased action in this articulation.

By injecting the hip-joint with liquid, either by perforating the trochanter major of the femur, or through a perforation in the cotyloid cavity of the innominatum, Bonnet found it possible to dilate the capsular ligament, or

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* Maladies des Articulations, tome ii. p. 259, et supra.

even to burst it, without causing any motion of the thigh,* the subject lying on its back, with the thigh extended.

The distention of the capsule in a forced injection, with proper precautions—that is, so as to get rid of the leverage caused by the length of the entire limb—creates, however, according to him, "certain movements of the thigh, that force it to take a fixed position, from which it does not change as long as the joint is kept distended by the injection," Fig. 352.

Fig. 352.
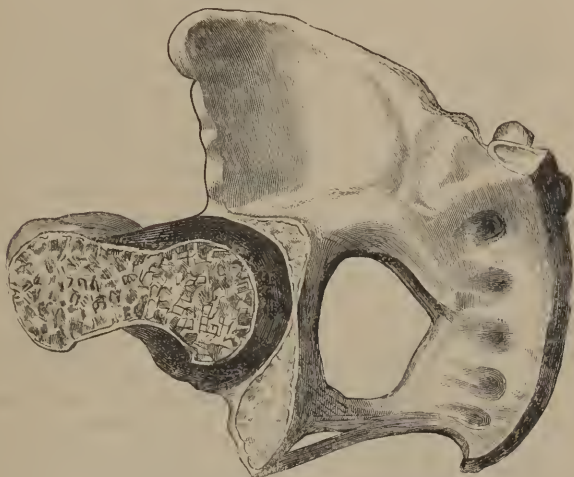


SECTION OF THE HIP-JOINT of the left side, as distended by a forced injection of water, or a thicker liquid, showing the flexion and abduction of the femur. (After Bonnet.)

If the liquid is forced so as to rupture the capsular ligament, the injection spreads itself into the surrounding areolar tissue. Hence he indicates three different phenomena as the result of this forced injection: 1st. Movement, and a fixed position of the thigh. 2d. Change of capacity and form of the capsular ligament. 3d. Its rupture, with the escape of the liquid contents of the joints into the surrounding tissues.

The movement and fixed position of the femur under these circumstances was proved by Bonnet to be invariably *flexion* at an angle of 60° with the parietes of the abdomen, the thigh being also invariably not only semiflexed, but abducted and rotated outward. These movements he regarded as due: 1st. To the pressure which the liquid exercised between the head of the femur and the acetabulum. 2d. To the fact that, as the capsular ligament scarcely permitted any extension in front, and on the outside of the joint, the head of the femur was most readily removed from the acetabulum on its lower and posterior edge; hence the flexion and abduction of the limb, the thigh being carried forward and outward in proportion as the head of the femur traveled backward and downward. 3d. By other experiments, he also showed that the greatest capacity of the capsular ligament (or of the joint) was in semiflexion combined with abduction of the thigh.

With these anatomical data, the explanation of some of the causes developing the symptoms of hip disease will be easily understood, while the folly of regarding the muscles, even when stretched, as the origin of the deformity, will be fully demonstrated.

* Op. cit. tome ii. p. 262, et supra.

**Symptoms.**—The earliest symptom noted in hip disease is more or less severe pain in some portion of the limb of the affected side, this sometimes following on a fall or blow, or becoming apparent without any known cause. If the patient is not old enough to explain the seat of suffering, the evidence of pain is to be noted in the indisposition to exertion or movement of the limb, or by the cries when motion is accidentally made. But if older, the seat of the pain will sometimes be referred to the hip-joint, or to the groin, though most frequently it is said to be on the inside of the knee,

Fig. 353.



A front view of Hip Disease on the right side, showing the apparent lengthening of the limb, together with its *abduction* and rotation outward, as indicated by the eversion of the foot. (After Bonnet.)

or sometimes at the ankle, the pain in the knee being often so marked that parents are misled by it in children, and present the little patient to the surgeon as suffering from disease or injury of the knee-joint. After this period, there is usually seen a flexion of the muscles of the thigh and leg, the patient supporting the body on the ball of the foot of the affected limb, with the pelvis inclined to the same side, Fig. 353. The pain in the knee, which is usually noted at an early moment, has by many been ascribed to the irritation of the obturator or internal saphena nerve near its origin, though the sensation, as in other neuralgic pains, is referred by the patient to the extreme nervous branches. Bonnet, however, regards this explanation of pain in the knee as unsatisfactory, because if due to the irritation of the branches of the internal saphena nerve, it should also be complained of in the leg and foot, to which this nerve is distributed. As in hip disease there is a modification of the position of the thigh, he is satisfied that there is also a modification of the relations of the knee-joint, the limb inclining— when the patient is lying down — to repose on the inner side of the heel, thus stretching the *internal lateral ligament* of the knee, and compressing it against the condyle of the femur —this being the rational explanation of the pain. He also expresses the opinion that frequently there is a coexistence of lesions in the two joints, having found much serum, and the synovial membrane congested in one knee he examined. That this explanation is based on correct anatomical data cannot be doubted, and there is, I think, good reason to regard the pain as due to the false position of the condyles of the femur caused by rotation, and the corresponding straining and compression of the ligament by the partially displaced internal condyle. As the tumefaction of the hip diminishes, and the rotation is changed, as in the second stage of hip disease, this pain is not complained of, yet there must be the same irritation at the origin of the nerve, or rather at the portion which passes near the joint. The absence of swelling in the knee, and of pain when it is pressed on, provided no motion is given to the thigh, will, however, generally pre-

vent deception as to the real seat of the disorder. The duration of this the first stage of the disorder, characterized by pain, flexion of the knee, and apparent lengthening of the limb, is varied, but is sooner or later followed by a new train of symptoms that characterize the second stage of the affection, and the accumulation of serum within the articulation.

As the inflammation of the joint is now more developed, we may notice a certain amount of tenderness and tumefaction about the part, especially on its anterior and internal face; pressure on the inner edge of the groin, over the psoas muscle, or near the origin of the pectineus, creating increased pain; while light percussion on the trochanter major, so as to drive the head of the bone into the acetabulum, or slight blows on the knee or foot, so as to force the femur upward, or the motion of abduction or forced extension of the limb, tend to augment the suffering. In this stage, instead of lengthening of the limb, there is usually marked shortening, the leg being semi-flexed on the thigh, and the thigh semiflexed on the pelvis, with a tendency either to abduction or adduction, the latter being most common, while the foot is disposed to eversion or inversion in accordance with the abduction or adduction of the thigh. The indisposition to motion is now usually followed by atrophy of the muscles around the joint, though the tumefaction

Fig. 354.                Fig. 355.



Fig. 354.—A FULL VIEW OF THE BACK AND BUTTOCK IN HIP DISEASE OF THE LEFT SIDE, showing the wasting of the glutei muscles, and the change in the line of the fold of the nates.
Fig. 355.—A FRONT VIEW OF HIP DISEASE OF THE RIGHT SIDE, showing the shortening, inclination of the pelvis, and flexion of the limb.

of the joint itself is marked. At the same time, the wasting of the glutei muscles is followed by flatness of the posterior fold of the buttock, the line of its lower margin being no longer transverse, as in the normal state, but forming rather an angle of 45° with the spine, Fig. 355. The symptoms

of constitutional disturbance are now also more apparent, the patient being feverish toward evening, unable to sleep, more or less disposed to constipation, and sometimes showing torpor of the liver, disposition to a sallow hue, with loss of appetite, emaciation, a distressed expression of the countenance, and great irritability of temper.

In the third stage, the local inflammation is more marked, suppuration and fluctuation, with swelling and heat, being readily noted around the joint. At this time, the skin over the joint is often smooth, shining, edematous, and congested, its veins being full and tortuous, with all the symptoms of deep-seated abscess.    As this progresses, the limb becomes very much shortened, flexed, and generally adducted, Fig. 356, and portions of the body submitted to pressure by the position of the patient, as the trochanter of the sound side, and the sacrum, give evidence of redness and the commencement of

Fig. 356.
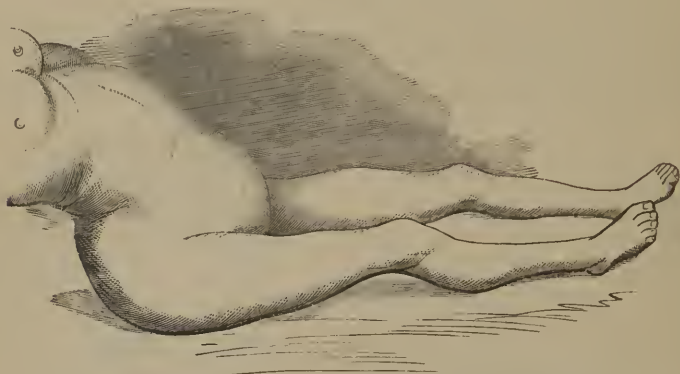


Hip Disease of the Left Side unaccompanied by Luxation, the Thigh on the diseased side being flexed, adducted, and rotated inward, so as to rest on the sound thigh.  (After Bonnet.)

"bed-sores."  As the fluctuation becomes more distinct, the integuments near the joint ulcerate, and give exit to a tuberculous and badly-formed pus that escapes most frequently from the posterior external side of the joint, though sometimes from its anterior and internal face.   When the pus escapes, the acute pain often diminishes, and the first openings may heal; but generally the pus is disposed to travel in all directions under the fascia of the thigh, the patient emaciates rapidly, and the symptoms of hectic are most marked.   With the ichorous pus that is often very offensive, there is sometimes seen portions of carious or necrosed bone, and a probe passed into the joint recognizes the diseased condition of the bones composing the articulation, though the disorder may be confined either to the femur or acetabulum.   As hip disease is mostly met with in the young, the recuperative powers of nature sometimes suffice to carry the patient through this stage, and a recovery follows, with deformity and shortening of the limb and anchylosis of the articulations, though sometimes death ends the suffering by diarrhœa, colliquative sweats, and the usual evidences of hectic.

In order to render the difference in these symptoms of the two stages of hip disease more apparent, they are here ranged side by side.

| SECOND STAGE. | THIRD STAGE. |
|---|---|
| Limb apparently longer. | Limb apparently or really shorter. |
| "    abducted. | "    adducted. |
| "    everted. | "    inverted. |

| SECOND STAGE. | THIRD STAGE. |
|---|---|
| Limb flexed on hip and knee. | Limb flexed on hip only. |
| Foot rests on sole. | Foot rests on ball only. |
| Pelvis lowered on diseased side. | Pelvis raised on diseased side. |
| " projected forward. | " projected back. |
| Nates low and flat. | Nates high and round. |
| Pain intense. | Pain greatly diminished. |

**Post-mortem Appearances.**—A post-mortem examination of the parts concerned in hip disease usually shows great purulent infiltration of the muscles, fascia, etc. around the joint, with numerous fistulæ running in all directions; perforation or destruction of the capsular ligament; congestion, softening, and destruction of the round ligament of the femur; softening and ulceration, or destruction of the articular cartilages, with caries of the head and neck of the femur; destruction of both of the latter; caries of the margin of the acetabulum, with sometimes its deepest portion perforated and opening into the pelvic cavity, or tuberculous cavities in the neck of the femur, with eburnation and porcellaneous deposit in its head, as well as on the corresponding portion of the acetabulum; while there are sometimes osseous growths around the acetabulum, or neck and head of the femur. At other times, when the patient has recovered, and ultimately died of tubercles in the lung, or some other disorder, an anchylosis of the femur to the acetabulum, or to the ileum, has been seen, or the old acetabulum is found filled up, and a new one formed adjacent to it, in which the head of the bone, changed in its shape, has made a new acetabulum, and enjoyed a considerable degree of motion. The question of spontaneous luxation, as the result of hip disease, will be again alluded to.

**Etiology.**—The causes of hip disease may be either constitutional or local, the latter seldom inducing the disorder unless there is some previous taint. The most common constitutional cause is certainly the tuberculous diathesis; tubercles forming in the head and neck of the femur, and subsequently softening and exciting local inflammation, precisely as when deposited in the lungs, vertebræ, or elsewhere. The rheumatic diathesis, however, sometimes develops hip disease, especially as Larrey has shown in the case of adults, while certain eruptive diseases have also been charged with its production. But why these general causes should act on the hip-joint rather than on others is not explained, and they, as well as the blows, falls, overexertion of the joint in playing foot-ball, and with exposure to damp and cold, checked perspiration, etc. may justly be regarded as causes inducing local congestion, which, like pneumonia, hasten the development of tuberculous matter that previously existed, or favor its formation. That the most common and serious cause of hip disease is constitutional disturbance, seems too well established to render the statement incorrect as a general rule, though to this, as to other general rules, there may doubtless be a few exceptions.

**Diagnosis.**—The diagnosis of hip disease is mainly difficult in its earliest or first stage, and requires a careful examination of the symptoms and their causes, especially in reference to the change in the position of the limb. For the elucidation of this latter point, the profession are greatly indebted to the observations of Bonnet,* who has methodically investigated the symptoms as characterized by "position in its causes and effects." In hip disease "he has never seen a case in which the thigh was not more or less flexed on the pelvis, or in which the axis of the femur and of the pelvis did

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* Op. cit. p. 267.

not form, as a general rule, an angle of 150 degrees," as represented in Fig. 357. "In this flexion the thigh may be inclined either inward or outward, the

Fig. 357.
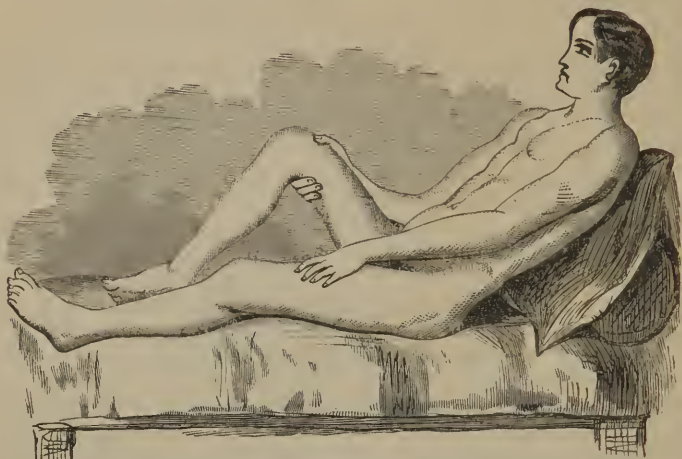


A view of Anchylosis of the Hip after Hip Disease, in which the affected Thigh and the Patient's Trunk cannot be placed at the same moment on the level of the bed. (After Bonnet.)

cases in which it is neither, being very rare. Flexion with abduction is often met with at first, but ultimately flexion with adduction is noticed. Abduc-

Fig. 358.



A view of the same Limb, as in Fig. 357, while the Limbs and Trunk are extended as much as is possible on the same level. (After Bonnet.)

tion of the thigh he has always found coincident with its rotation outward, hence eversion of the foot, as in the second stage; while rotation of the femur inward and inversion of the foot is the most frequently met with in the third, or later period. A valuable diagnostic sign in the early stage of hip disease will be found in the fact that, when flexion of the thigh has commenced, the thigh of the diseased side and the spine cannot be made to lie flat on the bed at the same moment. When the thigh is flexed, the back

must be raised, as in Fig. 357, or if the thigh is straightened so as to touch the bed, the back will be curved, as represented in Fig. 358.

"In examining these positions in reference to their value as aids to diagnosis, it must be admitted that flexion of the thigh is due to its being a natural position under most circumstances, when the hip-joint is distended by serum or pus; that abduction is the result of a necessary support to a limb when a patient lies on the back, and that flexion and abduction give the greatest capacity to the hip-joint. Hence their presence indi-

Fig. 359.
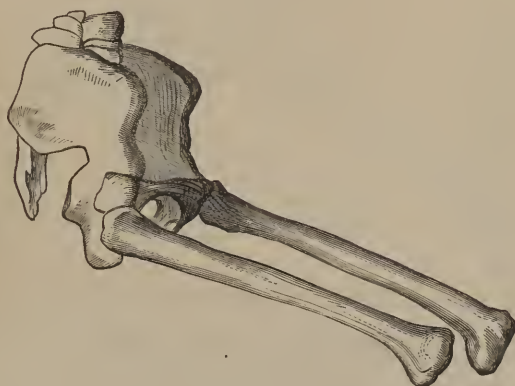


A view of the Pelvis, in which the two Femurs are flexed, the left side of the Pelvis being more anterior than the right, the Femur on this side appearing the longest. (After Bonnet.)

cates inflammation with effusion into the joint, or the first and second stage of hip disease in which they are mostly found. Flexion of the thigh, with apparent elongation of the limb, and an everted foot, is due to an inclination of the vertebral column and the pelvis to the affected side, Fig. 360, as this position takes the weight of the body off the head of the femur of the patient in standing, and also relaxes the psoas muscle, which passes over the front of the joint while he is lying down, thus relieving the latter from anterior pressure. Flexion with adduction of the thigh and inversion of the foot generally accompanies the last of the second stage and the entire third period, and in health distends the capsular ligament at its superior and posterior part, where it supports the head of the femur." As softening and ulceration are developed at this point, and the pus evacuated from the joint in this stage, while the edge of the acetabulum mainly yields at its upper and exterior circumference, the glutei muscles, aided by the position in bed, favor the escape of the head of the femur from the acetabulum, and hence luxation backward and upward of the head of the femur in the third stage not unfrequently supervenes, Fig. 359.

Whether the shortening of hip disease is ever due to luxation, is a question that has been extensively discussed, the majority of surgeons, from the days of Hippocrates, Galen, Celsus, and Albucasis, admitting its existence as the result of hip disease, while a few others, among whom in the United States are March, of Albany,[*] Gross, of Philadelphia,[†] Bauer, of New York,[‡] doubt it. That shortening may apparently exist, and yet be due to a

* Transact. Am. Med. Assoc., vol. vi. p. 479.
† System of Surgery, vol. i. p. 1014.　　‡ On Hip Disease, p. 13.

deviation in the pelvis from an inclination of the vertebral column, has been demonstrated by Bonnet, in Figs. 359 and 360.   That luxation does occur,

Fig. 360.



A view of the Pelvis, in which both Femurs are carried to the right side—the left one being the most inclined, and in this way appearing the shortest. (After Bonnet.)

and is often met with, is shown by various specimens in my own and other cabinets, of which the following cuts represent four, Figs. 361–364.

Fig. 361.                                          Fig. 362.



Fig. 361.—A THREE-QUARTER VIEW OF THE PELVIS OF A FEMALE WHO HAS HAD HIP DISEASE ON THE LEFT SIDE, showing a luxation of the head of the femur upward, and the formation of a new acetabulum on the edge of the dorsum ilii between the anterior superior and the anterior inferior spinous processes.   The old acetabulum is partially filled up, the new one as well as the head of the bone exhibiting evidences of caries.  The vertebral column is also curved toward the left side, and all the bones are quite thin.  This drawing is taken from a preparation marked No. 45 B of my cabinet. (After Nature.)

Fig. 362.—A FRONT VIEW OF THE CHANGES CAUSED BY HIP DISEASE, the head of the bone being much flattened and partially luxated backward, while the old acetabulum is so filled by new bony deposit as to change its appearance, and render the hip shorter and more prominent.  This drawing is from a preparation marked No. 47 B of my cabinet. (After Nature.)

Admitting consecutive luxations to be possible, as the result of hip disease, there can be but little difficulty in distinguishing them from other dis-

placements of the femur, as the latter are usually of short standing, while those from hip disease are only seen after long-continued diseased action. From the lengthening of the limb and eversion of the foot, sometimes seen in children as the result of partial paralysis, the similar condition met with in the first stage of hip disease may be told by the fact that all kinds of motion can be made in the hip-joint in this form of paralysis without pain, which

Fig. 363.  Fig. 364.

Fig. 363.—A FRONT VIEW OF THE CHANGES IN THE ARTICULATION AS MADE BY HIP DISEASE.—The head of the femur in this specimen is luxated just above the superior and posterior edge of the acetabulum, while the old acetabulum is partially filled up, elongated, and forms the inferior edge of the new acetabulum, bone having been deposited on its margin. The head of the femur is flattened, its neck is shortened, and the compact layer of the head extends over the neck. Both the head and new acetabulum are also eburnated at the points of chief contact. 1. Head of the luxated femur in its new acetabulum. 2. The old acetabulum, partially filled up, and changed in its shape. This drawing is taken from a preparation of the right ilium, which has been macerated and dried, and is No. 40 B of my cabinet. (After Nature.)

Fig. 364.—THE LEFT INNOMINATUM AFTER MACERATION AND DRYING, SHOWING THE CHANGES CONSEQUENT ON HIP DISEASE.—The old acetabulum is elongated and partially filled up, the head of the femur being entirely removed, and nothing of it left but a stump of the neck of the bone. This, by constant pressure on the middle of the dorsum of the ilium, has hollowed out a deep and large cup, which is convex on the venter of the ilium. 1. Remains of the neck of the femur as luxated. 2. The large new acetabulum made by the femur. This drawing is taken from a preparation of the left ilium, and is marked in my cabinet as No. 42 B. (After Nature.)

is not the case in morbus coxarius, while in these spontaneous luxations there is no difficulty in bringing both the thighs and the back to touch the same level on the bed. But, under most circumstances, the early symptoms of contusion of the hip, or rheumatism, or an abscess near the joint, are so similar to those of hip disease that caution in expressing an opinion is necessary, time and the progress of the disorder soon rendering the diagnosis clear. Pain in the knee, without swelling or increase of suffering on pressure, is suspicious; apparent lengthening of the limb and inability to walk without limping, is likewise strong evidence of a tendency to hip disease; and there are no other complaints that present these symptoms at an early period without there being something in the history of the case and age of the patient to aid the diagnosis. In measuring the length of the two limbs in diagnosing hip disease, the cautions given on page 613, and the liability to deception by an inclination of the pelvis, should be remembered.

Prognosis.—The prognosis in hip disease should always be guarded, both on account of the time necessary to carry out the treatment as well as from the character of the cure being always uncertain. The period required to accomplish a cure, even in favorable cases, is always considerable; and the patient and his friends should therefore be informed of this at the earliest moment; and though some patients do occasionally recover without deformity, and preserve the usefulness of the joint, yet such cases are *rare*. Under the treatment suggested and employed by H. G. Davis, of New York, we can, however, offer a more favorable prognosis than was possible a few years since.

Treatment.—In considering the best means of relieving this tedious dis-
order, it must be borne in mind that in its first stage there is an inflammation
established in the articulation, this inflammation being present whether the
disorder is due to constitutional taint resulting in the production of tubercles
in the cancellated tissue of the head and neck of the femur, or to an arthritis,
which, creating originally a mere synovitis, subsequently ends in caries.    In
either case, it must be admitted that an inflammation is set up which has a
tendency to produce changes in the tissues that compose the joint, to de-
velop abscesses, destroy the ligaments, and produce such alterations in
the articulating surfaces of the bones as will allow the contraction of the
muscles to draw the head of the femur out of, or on to the brim of the aceta-
bulum.    As the review of the symptoms of the disease just given shows a
variation of condition, so must the treatment, in order to be successful, be
adapted to the stage of the disorder in which the patient is presented to the
surgeon.

Thus, if the disease is seen in its first stage with the symptoms of acute
inflammation of the joint, the treatment should be strictly antiphlogistic,
leeches being at intervals applied around the joint, especially anteriorly, and
not over the trochanter, where they do no good.    After this a splint should
be promptly applied, or extension made, so as to keep the head of the femur
from pressing against the acetabulum.    This was formerly done by keeping
the patient in bed, and applying extension and counter-extension, by means
of a carved angular, or straight splint.    The principle of rest, as a means of
cure in an inflamed joint, appears, however, to have been erroneous, as
proved by Bonnet in the experiments before alluded to.    Hence, after free
leeching, it will be found preferable to employ such mechanical means as will
draw the head of the femur out from the deep surface of the acetabulum, but
yet permit gentle exercise of the joint, a certain degree of motion being
essential to the proper circulation and the prevention of inflammatory soft-
ening, or the so-called ulceration of the articular cartilage.    To accomplish
this, I recommend the application of the splint of H. G. Davis, of New
York, who, after twelve years of investigation, has greatly modified the re-
sults of the usual treatment of this serious disorder.    As a just testi-
monial of appreciation of his improvement, and to guard against any de-
parture from the means which his experience has proved to be most suc-
cessful, I give in full his plan of treatment, simply stating that for two years
I have pursued it with the most satisfactory results.

On the Mechanical Means adopted in the Treatment of Morbus Cox-
arius by H. G. Davis, M.D., New York.*—The several parts employed in
this plan are four strips of adhesive plaster, as hereafter described, a roller
to confine them to the limb; firm webbing to be attached to the lower
end of the adhesive plasters when upon the limb; a cord, pulley, and
weight, for extension when upon a bed or couch; and a corrugated steel
splint, with a perineal band, composed of two parts—an inelastic and an
elastic—arranged in a peculiar manner, so as to keep up extension while
the patient takes exercise within the house or in the open air.

When called to treat a case of morbus coxarius, bring the tibia in a line
with the femur, but attempt no change in the direction of the latter if it is
not parallel with the body.    If the femur is flexed upon the pelvis, the body
should be raised until the limb will lie extended upon the mattress or couch.
Adhesive straps should then be placed upon each side of the limb, in the
following manner: First, double over one inch of each adhesive strap de-
signed for the sides of the limb, bringing the adhesive surfaces in contact for

the purpose of increasing the strength of the part, to which a firm inelastic webbing, six or nine inches long, should be stretched. The plaster for the outside of the limb should then be applied to the folded end mentioned, at a point one inch above the external malleolus, and extended to the region of the great trochanter; that upon the inside, from one inch above the internal malleolus to within one inch of the pubis. Upon the lower end of the adhesive strap, on the outside of the limb, commence with a narrower and longer one, and run it spirally around the limb until it reaches the upper end of the longitudinal straps; another should then start from the same point upon the outside of the limb, but wind in the opposite direction. These spiral strips accomplish a twofold purpose: they connect the outside longitudinal adhesive plaster with that upon the inside of the limb, so that any extension made upon the outside plaster is shared by that upon the
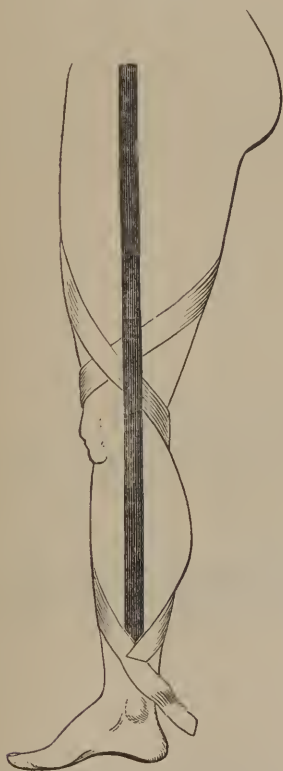
Fig. 365.                    Fig. 366.
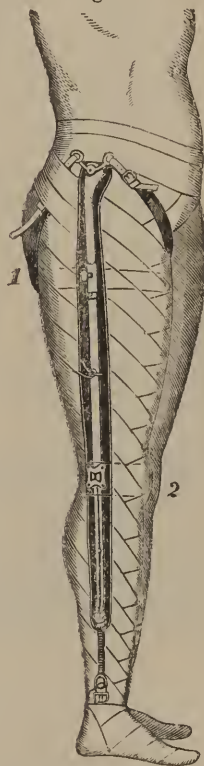


Fig. 365.—A side view of the adhesive straps as applied to the limb, showing their course and relation to the splint. The ends of the straps have not yet had the webbing sewed to them, but are represented loose. (After Davis.)
Fig. 366.—A three-quarter view of Davis's splint as fully applied to the limb. This splint is placed outside the bandage, and held in position by the extending and counter-extending bands at its two extremities, as well as by the straps shown at 1, 2. (After Nature.)

inside. This arrangement also secures the bottom of the outside longitudinal plaster from being displaced laterally when the splint is applied, always retaining it in a line with the limb. The width of these plasters varies from an inch and a quarter to two inches and a half, according to the size of the patient, Fig. 365, the latter being wide enough for a patient of some years.

When the extension is made by the application of the splint, it is always by the outside strip, and upon the outside of the limb; at other times, as when the patient is in bed, and the weight is used, it should be made from both sides, by tying the two pieces of webbing together (that from the inside and that from the outside strap) in a loop below the sole of the foot, the cord to which the weight is attached being made fast to the looped webbing. The latter mode of extension supports the sides of the foot equally, and is, therefore, preferable when the patient is upon the bed or couch, and without the splint.

Before proceeding further, a word may be said upon the character of the adhesive plaster to be used for this purpose, as that ordinarily used for dressing wounds will only disappoint the surgeon. It should be spread upon twilled goods, as they are more elastic; and when the extension is made, the parts first affected will yield until the whole surface of the plaster bears a portion of the draught; whereas plaster upon plain cloth draws only in a straight line, and therefore is only applicable to an even surface.

The material of the plaster should not only be good, but it should have been spread upon the cloth for at least one year, and it is still better if two years old; age oxydizes the oil, rendering it resinous, so that the oily secretions from the skin do not readily soften it. Plaster of this description has remained upon an adult for seven months, sustaining a weight of twelve pounds every night, and not unfrequently during the day a considerable portion of the entire weight of the body.

Fig. 367.
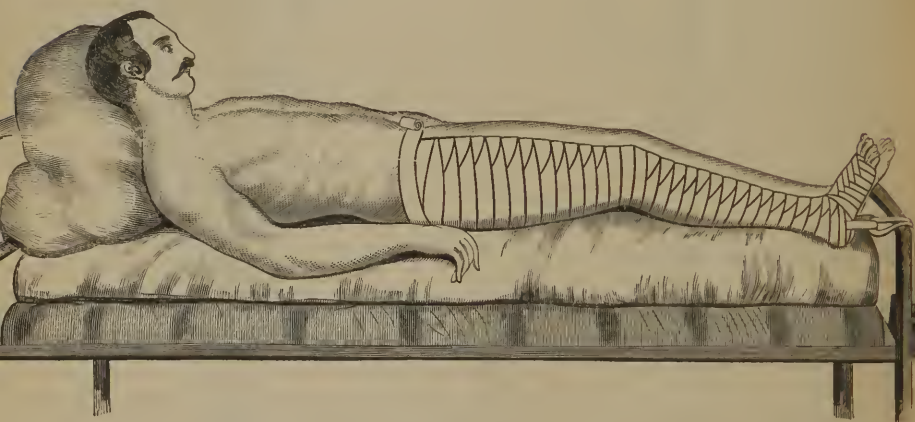


A view of the extension made by a weight attached to the loop of a webbing, and applied whenever the patient is in bed. (After Nature.)

After the application of the adhesive straps in the manner described, the limb should be covered with a spiral bandage from the foot to the pelvis, to secure firm adhesion of the plasters, also to prevent their edges from being raised by coming in contact with the clothing, Fig. 366, or by the hands of the patient during sleep. This bandage should be applied to the limb for some hours, with the patient warm in bed, before any traction is made upon the adhesive straps, so that the latter may become firmly adherent to the limb. After this time has elapsed, a weight, varying from two to six pounds, according to the strength of muscle and the sensibility of the joint, may be attached to the webbing fastened to the ends of the adhesive straps upon each side of the limb, by tying the webbing in a loop and attach-

ing to it a cord, so that it may run over a small pulley or block, secured to the foot of the bed or couch, or over the round of the bedstead, the top of the pulley being a little above a line with the centre of the limb, Fig. 367. This weight should be increased from day to day, until a general sensation of fatigue is felt in the entire limb to an unpleasant extent, and then diminished until it just falls short of this point. The extension should be first made at that angle with the body held by the limb, the shoulders being elevated by

pillows. As the tenderness of the joint subsides, the body should be gradually lowered until it is brought in a line with the limb. When this is effected, the splint can be applied, and the patient put upon crutches and permitted to exercise.

When the splint is applied, the piece of firm, strong webbing fastened to the outside adhesive strip passes over the lower end of the splint, and is inserted into a buckle on its outside, near the joint, the inside band is then simply curled around the ankle.

The counter-extension is now ready for the splint. This is made of steel, of sufficient width and thickness that, when corrugated as it is in the splint, it will sustain the weight of the patient without yielding; and it is surprising how little thickness of steel it requires to fulfill these indications when put into the corrugated form. A strip, one inch and a half wide, of No. 16 rolled cast-steel, when corrugated, will sustain, endwise, the weight of an adult, without yielding.

The splint is represented in the cut. If the webbing attached to the plaster is wider than the bottom of the splint, it will contract over the corners sufficiently to retain the splint in its fold. To make it still more secure, the lower end of the splint can be cut into, forming slight grooves, into which the threads of the webbing will draw, and thus prevent displacement. Just below the joint, in the splint, (6,) is the button for the attachment of the buckle, before mentioned. Quite at the top, and inside of the splint, is an eye, through which runs a lever, to which are attached the two ends of a perineal or counter-extending band, when the



Fig. 368.
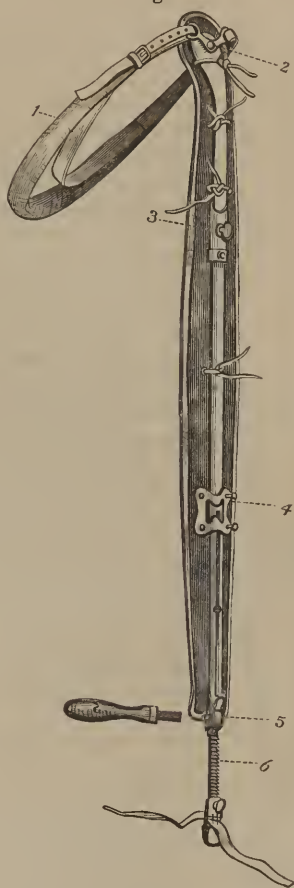
A VIEW OF DAVIS'S CORRUGATED STEEL SPLINT FOR HIP DISEASE.

1.—Elastic perineal band for counter-extension, the outside band being an additional support.
2.—The lever joint to permit the play of the counter-extending band as the patient walks.
3.—A sliding joint to permit the lengthening or shortening of the splint. The thigh circular strap is attached to the pin in this joint, to hold the strap in position.
4.—A piece to receive the band that surrounds the knee.
5.—A screw moved by a handle, and extending the bar to which the extending band is buckled.
6.—The extending bar racked so as to be moved by the screw in extension.

splint is applied to the patient; this lever allows the upper portion of the splint to traverse back and forth without disturbing the perineal band. All of that portion of the splint that passes above the hip-joint has a motion, of which the joint is the centre, the perineal band being thus undisturbed by any motions of the limb, and all irritation from friction avoided. Between the splint and the limb is placed a flat piece of padded leather, to prevent irritation. The perineal or extending band is a very simple though a very important contrivance. It is so arranged that any amount of extension can be made; yet, when the patient steps upon the limb, it yields no further.

There is, first, an elastic band, one or one and a half inches wide, made of the very best rubber, or rubber webbing, to which two buckles are attached, one at each end. In addition, there is a piece of inelastic webbing that is from eight to twelve inches longer than the elastic band mentioned; this passes through the buckles in such a direction that when extension is made

Fig. 369.



A front view of the splint as applied to the limb after the plaster is firmly adherent, the turns of the bandage covering the strips being omitted in the cut. (After Davis.)

upon each end, the buckles take hold of the webbing and confine it. By this arrangement of the two bands they can be buckled at different lengths; by leaving the outside inelastic band loose between the buckles, any draught applied at the ends of the inelastic will be communicated to the elastic band, extending it until it is of the same length as that portion of the inelastic band contained between the buckles; then the latter will prevent any further extension. It will now be perceived how a certain amount of extension can be kept up; yet when any additional labor is thrown upon the splint, as when the patient leans upon the limb, it will yield no further. The splint is also secured to the limb by a strap at the knee, Fig. 369, as well as in the middle of the thigh. The loose ends of the inelastic webbing may be folded back upon themselves, and introduced into the buckles. Both ends of the perineal band are secured to the buckles after the latter is placed in the eyes of the lever at the top of the splint; the whole forming a loop that can be put upon the limb over the foot without disturbing any part. For a cushion beneath the perineal band, we may use old table linen, or old napkins that are soft; they should be folded an inch wider than the perineal band, and a little longer; after folding, the parts should be caught with a needle and thread, to prevent their displacement.

These cushions should be changed every second day, particularly during warm weather, as they collect the secretions, and then are liable to excoriate the parts. For the first few days, care should be taken that the splint is not kept on, after anything like a sensation of heat or smarting is experienced in the groin. If proper care be observed at first, the parts beneath the perineal or extension band will have become so hardened as to render any excoriation improbable. Whenever the splint is removed, the extension by means of the weight should be applied, that the diseased surfaces of the joint may be constantly kept separated. The splint is intended to fit closely to the outside of the limb, and to be worn inside the stocking. That this may be done, and also that it might be worn unperceived, all additions to its thickness have been avoided, and irregularities upon its surface have been guarded against, as they would soon wear a hole through the clothing, and thus become obnoxious. Where the patient

is an active, restless child, the splint may be secured yet more firmly by the application of a second spiral bandage, though this is not usually necessary.

The advantages of this plan of treatment are :—

1. "It relieves all suffering after the limb is brought down in a line with the axis of the body, and the sensibility of the joint has had time to subside ; but from the commencement, there is a decided mitigation of pain. The time requisite to bring the limb down varies from one to twenty days, according to the tenderness of the joint and the contraction of the muscles. As a rule, whenever the patient complains of pain, we may be certain there is not the proper amount of extension upon the limb.

2. "It retains the limb in the best position as to length, etc., whatever may be the result to the head of the bone.

3. "It puts the diseased parts in the best position for their restoration with a perfect joint, as it relieves the pressure upon the head of the bone, while, at the same time, it admits of motion, which increases the recuperative energy of the parts, inasmuch as it increases their vitality.

4. "In consequence of the favorable results mentioned, the patient's life will rarely, if ever, be sacrificed to the disease.

" The relief afforded the parents and friends of the patient might be mentioned, as there are few diseases that make a greater demand upon the sympathies and physical efforts of friends than that of hip disease.

" The relief from irritation afforded by separating the head of the bone from the upper portion of the acetabulum must be seen in order to be appreciated. Patients with very depraved constitutions, where large abscesses had formed about the joint, in whom hectic fever would have been sure to follow their evacuation under the old mode of treatment, have, while extension was kept up, not had an unpleasant symptom, not even so much as any impairment of the appetite."

This has been confirmed in a remarkable degree by my own experience in several instances where I have fully tested Davis's plan of treatment.

It will not be expected that every case of morbus coxarius, although treated upon this plan from the commencement of the disease, will recover with a perfect joint ; yet we can safely rely upon a far larger percentage than by any other mode. In addition, whatever may be the point at which the disease stops, the limb will be left in the best condition possible, considering the loss of structure sustained. If the head of the femur should be entirely destroyed, the limb should be kept at its full length ; and if anchylosis takes place, it does so without material shortening of the limb. If a patient should recover from the disease while wearing the apparatus, great care is requisite that it be not laid aside too soon ; the necessity of this caution becomes evident, when we consider upon how small a surface of the head of the bone, or of the cavity of the acetabulum, must rest the whole weight of the body, and frequently many times its weight, as in jumping, etc.

Again, this very small surface is the portion that has just recovered from disease, or, in other words, is a fresh cicatrix, the vitality of which is less than that of the original structure. There is yet another consideration : if inflammation takes place in this part, it will be of a far more active character than that with which it was at first affected, and will very probably speedily result in suppuration if not subdued. The remedial measures should be much more active, particularly the local treatment, than in any ordinary case of hip disease.

With the long experience of the profession in the success and result of hip disease under the treatment by rest and confinement to bed, it may appear that the results of Davis's method are exaggerated ; but this is not so, and I fully indorse the marked advantages claimed for his plan, regarding

his method as a great boon to suffering humanity. As the trifling mechanical modifications of Davis's splint that have been suggested by others in no way change the principles that he has laid down, it is unnecessary to notice them.

During the entire treatment by Davis's splint, strict attention should be given to the condition of the patient's digestive organs, and laxatives administered to guard against constipation. The administration of tonics and chalybeates, with good nutritious food, fresh air, and exercise, will greatly expedite the cure, by improving the general tone of the blood, and modifying the local nutrition in the diseased joint.

With the experience of past years, it will probably be some time before general confidence will be given to a plan that permits motion in an inflamed articulation, yet I have seen a child in the third stage of hip disease, with a large abscess around the hip, and the tissues suffering from marked inflammation, running about on a crutch, with one of Davis's splints well adjusted to its limb. Under the use of this splint, the extreme flexion and adduction of the diseased thigh will soon disappear, or be greatly modified. Even in cases of extreme flexion of long standing, the gentle, long-continued extension and counter-extension effected by this splint has greatly improved the limb, and diminished the deformity with its admirable **continuous extension,** as furnished by the elasticity of the perineal band of India-rubber.

Resection of the head of the femur—myotomy and tenotomy—with tapping of the inflamed joint, with a view of expediting the cure, only need to be mentioned to be disapproved of. Such operations can no longer be regarded as justifiable in the treatment of hip disease.

### § 4.—Movable or False Cartilages.

Under certain circumstances, foreign bodies of a cartilaginous or fibroligamentous character have been found in connection with either the internal or external surfaces of the synovial membrane of several of the joints, as the jaw, elbow, and shoulder, but especially that of the knee. To these have been long given the name of **Movable or False Cartilages**. The number, size, shape, and structure of these cartilages vary greatly, presenting every variety, and sometimes offering a point of osseous matter in their centre.

Two theories have been offered in explanation of their formation: one regarding them as new formations, or as separation of fragments of the articular cartilages of the joint; the other, as Kölliker, considering them as due to the non-vascular folds of the synovial membrane, (plica synovitis.) These folds form movable cartilages by increasing in size and solidity under various sources of irritation, and becoming subsequently detached from the vascular folds furnishing the synovia, to which, in the normal state, they are attached.

"These bodies, according to Kölliker,[*] consist of connective tissue, with elongated nuclei, coated with epithelium, and contain a variable number of scattered fat and true cartilage cells. They are not developed externally to the synovial membrane, but from an outgrowth of this membrane itself." Kölliker and Virchow regard them as fibrinous exudations in many cases, and in others, as solidified deposits from the synovia. "Portions of bone, detached from outgrowths at the circumference of the articular ends of the bones, may find their way into the interior of the articulation."[†]

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* Kölliker, p. 208. Philadelphia translation.       † Op. citat.

**Seat.**—False cartilages are found mainly in the knee-joint, on the outer surface of the synovial capsule, to which they are often attached by a pedicle, or in the connective tissue adjacent to it. In the latter case, they sometimes perforate the synovial membrane little by little, and are then found loose in the joint.

**Symptoms.**—The evidence of the presence of false cartilages in the knee-joint is often exceedingly sudden, the patient instantly being seized with a sharp-cutting or pinching pain, which causes him to drop, or renders motion of the joint for the moment almost impossible. At periods that vary, this pain is renewed, from time to time, in certain movements of the joint, especially those that induce relaxation of the ligaments. After lasting a period that varies greatly, and especially in patients compelled to walk a great deal, this pain may be followed by the symptoms of chronic arthritis from other causes, or by hydrops articuli, or dropsy of the joint.

In examining the joint carefully by the touch, especially on the front and sides of the knee, near or below the patella, a hard, movable body may be recognized that slips freely under the fingers, gets behind the patella, or may be pushed from one side of its ligament to the other. These bodies have no definite position, though most frequently I have seen them on the inner side of the joint. Varying the position of the limb, so as to relax or tighten the capsular ligament, will often render them apparent.

**Diagnosis.**—When complicated with chronic arthritis and its results, the diagnosis of these bodies is often difficult; but when uncomplicated, and they can be felt, it is quite easy.

**Prognosis.**—Movable cartilages often exist during life, without causing more serious inconvenience than a restricted use of the limb and the occasional pain, that is, as stated, often quite severe. They cannot be removed by resolution, may be kept fixed by an appropriate bandage, and, when operated on, expose the patient to considerable risk of his life.

**Treatment.**—When movable cartilages develop chronic arthritis, the treatment advised for the relief of the latter will be demanded; but no attempt at the removal of the cartilage by extirpation can be practiced when these symptoms are present.

Fastening the cartilage by transfixing it with a pin and figure of 8 suture, and preventing sudden relaxation of the capsular ligament by surrounding the joint with the elastic bandage, is the safest mode of treatment, and in very many cases all that is necessary.

If the inconvenience is so great that extirpation is absolutely demanded, care should be first taken, by appropriate treatment, to remove all arthritic inflammation, and then such a subcutaneous valvular incision should be made over the foreign body, firmly held, as will enable it to be freed and allowed to escape into the areolar tissue exterior to the joint, as will be again alluded to in vol. ii.

Any attempt at direct extirpation of a false cartilage—that is, by a direct opening into the joint—should be discountenanced as dangerous to the life of the patient, in consequence of the connection of the cartilage with the synovial membrane.

## LIST OF AMERICAN PAPERS ON DISEASES OF THE JOINTS.

On Coxalgia or Hip Disease, by Alden March, M.D.  Albany, N. Y.—*Transactions American Med. Assoc.*, vol. vi. p. 479.                    1853.

On the Mechanical Means adopted in the Treatment of Morbus Coxarius, by H. G. Davis, M.D.  New York.  (With a plate.)—*New York Monthly Review of Medical and Surgical Science*, and *Buffalo Medical Journal*, vol. xv. No. 11, p. 678.
                        April, 1860.

Report on Morbus Coxarius, or Hip Disease, by Lewis A. Sayre, M.D.—*Transactions American Med. Assoc.*, vol. xiii. p. 469.                    1860.

# PART X.

## AFFECTIONS OF THE TENDONS AND BURSÆ.

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## CHAPTER I.

### PARONYCHIA.

**Paronychia,** (παρα, by, and ονυξ, the nail,) or the **Whitlow** of common language, is the term applied to certain inflammations of the fingers and toes, and especially of the first phalanges.

**Varieties.**—Four varieties of the disease are usually made by authors for the purposes of methodical study. But as the affection presents itself to the surgeon, these forms not unfrequently complicate each other to a considerable extent.

1. In the first variety, we have a very superficial inflammation upon the dorsal face of the finger; pus forming around the matrix of the nail, and resulting generally in the destruction of the connection between the nail and the soft parts, while the nail falls out. This variety, strictly speaking, should pass under the designation of **Onychia,** which was the term uniformly applied to it by the old writers, and is the complaint which in common language is designated as a **Felon,** while to paronychia the popular term **Whitlow** is applied.

2. In the second variety, pus is found in the areolar tissue, which constitutes the pulp of the extremity of the finger.

3. In the third, the inflammation travels still deeper, and is found to involve the theca or sheath of the flexor tendons—seldom of the extensor tendons—a circumstance which is due probably to the fact that the palmar face of the finger is more exposed than the dorsal to violence from accidents and other causes likely to produce inflammation.

4. In the fourth variety still deeper parts are invaded, the pus being now found beneath the periosteum of the phalanx involved.

When these varieties of the complaint are examined, it is easy to perceive that they differ from each other only in extent. In all, the disease consists essentially in inflammatory action, resulting in the formation of pus, the position of the seat of the inflammation being all that constitutes the varieties of the complaint. The symptoms, therefore, under all circumstances, may be described as those of inflammation, differing only in degree.

**Symptoms.**—The symptoms of the first variety, which is a simple inflammation that is circumscribed in extent and superficial in position, are first, a burning pain and slight circumscribed swelling around the matrix of the nail. The disease, therefore, is found chiefly on the dorsal face of the fingers and toes, and the inflammation and swelling seldom extend beyond the limits of the first phalanx. The skin covering the part goes through all the changes of color which would be anticipated in a superficial inflammation, becoming dark red from capillary congestion, then violet, and by-and-by more or less bluish, according to the chronic character of the complaint. Owing to the thinness of the skin of the part, so soon as the pus is formed it shows itself as a yellowish band, surrounding the root of the nail. At last, the distention causes the skin to burst; the pus is evacuated, and the loosened nail comes off, being elevated *first from the matrix.*

The new nail is generally found beneath the old, as the latter is thrown off, or is formed soon afterward. But it is often vitiated in character, being sometimes harder and more horny than the normal nail, or if not vitiated in character, often takes an unnatural direction, becoming incurved, this incurving in the toe being not unfrequently a cause of what has been designated as "ingrowing of the toe-nail." Among the laboring classes, the symptoms of the complaint are more severe; and, as the skin is thicker, the pus finds greater difficulties in the way of its escape. The pain is therefore more violent, and the suffering and constitutional disturbance more marked.

In the second variety, there is an increase of all the inflammatory symptoms, and especially of the pain, because there is here a dense cellular tissue, containing the delicate nervous filaments connected with the tactile papillæ, and it is easy to perceive that when pus is effused in such a structure, violent pain must be the result. The swelling is, therefore, more dense and hard, the fluctuation more indistinct, and the pus frequently not perceptible until it has accumulated to some amount; consequently, in this variety, the matter has a greater opportunity to travel than in the last, and it may go to such an extent as to result in the formation of the third and fourth varieties, which will readily happen should it involve the theca of the tendon, or the periosteum of the bone.

In the third variety, in which the theca of the tendon is involved, the pain is more severe, often quite excruciating and lancinating, going up as high as the axilla, and in this respect resembling the pain in the fourth variety. The swelling also is more marked, extending often to the second and third phalanges, Fig. 370, and even upon the palm of the hand; while the congestion and obstruction in the capillary circulation may be such as to give rise to erysipelas.

Fig. 370.



Paronychia of the Thumb, showing the Swelling and Disorganizing of Tissue.

In the fourth variety the symptoms are the same, though, if possible, in a still higher degree, there being more marked constitutional disturbance, the patient sometimes remaining for days unable to sleep, and in a high state of nervous excitement.

In any of these varieties, as soon as the distention of the skin has gone beyond the point which its elasticity can bear, it cracks, or ulceration is established, and the pus is evacuated. With the pus comes away more or

less of a slough, or "core," as it is called in common language, involving often the theca of the tendon or the tendon itself, portions of which may also come away, after which the bone may become necrosed, and the whole phalanx, or even the finger, Fig. 371, be destroyed. From the ulcer, fungous granulations begin by-and-by to sprout, and the condition which results is not unlike in appearance certain forms of malignant disease. In this general survey of the symptoms of the more severe forms of paronychia, those of the constitutional irritation ought not to be neglected, being those of irritative or traumatic fever generally, to which allusion has already been made in connection with the subject of inflammation.

Fig. 371.



Caries of the Phalanges, as the result of badly treated Paronychia.

**Etiology.**—The causes of paronychia are often not very apparent; the disease being sometimes undoubtedly due to epidemic influence. Within the last few years such an epidemic has spread through the United States, sweeping not only along the Atlantic coast but down the valley of the Mississippi, and affecting persons of all classes. Sometimes the origin of the disease can be traced to a blow; sometimes to the little loose piece of cuticle near the root of the nail, familiarly spoken of as "widows" or "old women." It may also be due to the sudden warming of the hands after exposure to cold, and hence coachmen who drive in cold weather are apt to suffer. Sometimes it is created by puncture, as by a sharp-pointed instrument, the third and fourth variety being especially due to such causes. Waiters and cooks, from punctures by forks, etc., therefore frequently suffer from the complaint.

**Diagnosis.**—The seat and history of the disorder will generally suffice to render the diagnosis easy.

**Prognosis.**—The prognosis will depend upon the variety of the disorder, and upon the time which has elapsed before it was seen by the surgeon. Thus, the inconveniences resulting from the first and second variety are comparatively slight compared with those which may ensue on the third and fourth. If the pus is allowed to travel it will do mischief, and the prognosis will become much more grave; and hence it is that the disease generally eventuates in greater necrosis if left to itself than if submitted to appropriate treatment. Under all circumstances, the prognosis, so far as a perfect cure is concerned, should be guarded, the disease being very apt to result, especially in the last variety, in the loss of the joint.

**Treatment.**—The indications in the treatment are very simple, and may all be summed up under one head, and that is, the early evacuation of the pus, and the free division of the tissues so as to prevent the inflammation from spreading and involving the neighboring parts. By the words "early evacuation of the pus," I mean its evacuation within forty-eight hours after the symptoms have become well marked; and this is not only the safest, but also the most efficient plan, being the only one likely to save the finger. In the milder form of the complaint—that, for example, which is connected with the root of the nail, or that which involves only the pulp of the extremity of the finger—if the patient is timid and dreads the knife, or the physician is unwilling to make an incision, the pus may be evacuated by creating an ulcer which shall perforate the integument, through the application of caustics, as suggested about the year 1800 by Dr. Perkins, who effected his object by means of a caustic consisting of white vitriol,

corrosive sublimate, etc.    The same thing, however, may be accom-
plished by the caustic potash, and the integuments perforated in precisely
the same way that we would form an issue, a piece of kid with a hole in it
of the size of the intended eschar being first bound upon the finger and the
caustic applied.    When the slough comes away, the pus will be evacuated;
but this mode of operating is both more tedious and more painful than the
operation by the knife.

Should the surgeon fortunately see the case before forty-eight hours have
elapsed, which is rarely done, he might attempt to check the inflammatory
action by antiphlogistic measures, as leeches freely applied, cold lotions, etc.
But it must be admitted that these means present but little chance of
success.    Stimulating applications are sometimes popularly employed by
patients and their friends in the treatment of these cases, and it is easy to
perceive how such applications act, as there is a dense unyielding tissue,
seized by inflammation, which is increased and hastened to an issue by the
formation of a slough, the pus being evacuated, and the patient relieved
when it comes away.    The common applications to whitlows, such as
brown soap and sugar, shoemaker's wax, soaking the finger in strong lye,
a lye poultice, etc., act upon the same principle.    Another application,
which is stimulating from the ammonia which it contains, is one which is
common in the country among the lower classes, to wit, the cowdung
poultice; human urine (chamber-lye) also probably derives its real or
supposed efficacy from the presence of ammonia.

But although these popular applications may at times, and when nothing
better can be done, possess a certain amount of efficacy, the educated sur-
geon will never hesitate about the course which he ought to pursue, but
will proceed at once to lay open the diseased tissues and evacuate the pus
if any have formed.    And this must be done boldly and without fear or
hesitation.    A very slight reference to the structures concerned will show
that such an incision is really a very simple operation, and one which does
not involve the slightest danger, the course of the flexor tendon being
directly along the centre of the finger, while the artery and nerve are on
each side.    If, then, the incision be made lengthwise and along the centre
of the finger, there is no danger of wounding the latter organs.    The in-
cision should be made directly down through the theca and tendon to the
bone itself, and should extend the whole length of the phalanx affected, but
not involve the subjacent tissues.    If more than one phalanx is diseased,
several incisions should be made, the number of incisions corresponding
with the number of phalanges involved; but one incision should not be
allowed to extend the length of two or three phalanges, because as this
would cross the joint, the capsular ligament might be opened and an
inflammation created which might involve the loss of the articulation.    The
incision should be made with a scalpel or bistoury, the scalpel being pref-
erable, and the importance of cutting through the periosteum, if the pus is
forming between that membrane and the bone, cannot be over-estimated,
for, as the phalanx derives its nourishment from the periosteum, and the
pus separates the two, an accumulation of pus in this locality must terminate
in necrosis of the bone.    If the patient dreads the pain of the operation,
anæsthetics may be administered.

The relief experienced after the operation is generally great and speedy.
Indeed, the first night's rest the patient has experienced for some time is often
that following the operation.    Should, however, this not be the case, some
anodyne may be prescribed.    The after-treatment requires attention; as
the exuberant granulation must be guarded against.    At first, warmth and
moisture are the means to be employed, the finger being surrounded in a
sheath of spongio-piline, made like a finger-stall, but if this cannot be

obtained, a flaxseed poultice may be substituted, and the whole covered with oiled silk. Then, after a few days, when the suppuration has ceased, the granulations which begin to form from the bottom of the wound should be regulated in their progress by touching them with the nitrate of silver.

The subject of paronychia is one which demands careful attention from the surgeon, as the loss of the joint which it very frequently involves is a serious matter, and can generally be avoided by proper treatment. Sometimes, however, notwithstanding the best treatment, more or less deformity, contraction of the finger, etc. will result from the complaint, and the surgeon should always advise the patient of this fact when undertaking the treatment of the case.

Patients, however, frequently do not apply for advice until the pus has found its way to the exterior by, perhaps, several circuitous routes, these fistulous orifices continuing to discharge for a long time. There are also portions of fibrous and tendinous tissues which slough from the violence and long continuance of the inflammation, and the bones likewise often become necrosed.

Such cases should be treated by carefully slitting up each of the fistulæ, and causing them to heal from below. The dead tendons should be cut away, and the separated portions of bone removed by the forceps. Even when the whole of the distal phalanx is dead, this mode of treatment is preferable to amputation, because the end of the finger when saved will prove of great service, even though not perfect in its formation. It has been found, moreover, that the periosteum will, in these cases, partially reproduce the bone. Indeed, Toland, of California, has recorded* a number of cases, in which he states that not only were the phalanges, but also the joints reproduced after their removal.

# CHAPTER II.

## AFFECTIONS OF THE BURSÆ MUCOSÆ.

### SECTION I.

#### CHRONIC INLAMMATION OF THE BURSÆ.

A REFERENCE to the anatomy of the different parts of the muscular system shows that certain points where the muscles pass over bones, as well as the sheaths of certain tendons, are lined by synovial membrane and *bursæ*, or little sacs which contain synovia. These are found in connection with the tendons of the wrist-joint; with the tendon of the patella; with the muscles inserted into the trochanter major of the os femoris; with the ankle, etc. Now, at any of these points there may be such a modification of the action of the bursal synovial membrane as will lead to an accumulation of the fluid within the sac, and the formation of a tumor. This enlargement generally ensues upon over-exertion, upon pressure, or upon any such causes as would develop chronic inflammation in a synovial tissue. Like chronic inflammation elsewhere, this sometimes results only in an increased secretion of the part; but sometimes it goes still further, and lymph is poured out into the cavity of the sac, the partial organization of which

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* Charleston Med. Journ. and Review, July, 1858.

leads either to the formation of a solid tumor, or to those peculiar carti-
laginous, rice-shaped bodies which are occasionally found in enlarged bursæ,
and of which there are several specimens in the Wistar and Horner Museum
of the University of Pennsylvania.

**Varieties.**—Different names are given to these increased effusions in the
bursæ, according to the localities in which they are found: thus those in the
bursæ of the tendons on the front and back of the wrist-joint are called **Gan-
glia**, while those about the knee-joint are designated as **Housemaid's Knee**.

**Symptoms.**—The symptoms of enlarged bursæ are generally easily recog-
nizable.    Thus, there is a tumor formed by the accumulation of either
synovia or fibrin, or both, mixed within the sac, this tumor being more or
less globular in its shape, and generally presenting more or less fluctuation
in it.    Sometimes, however, the contents of the sac so distend it that fluc-
tuation can hardly be perceived, and then it is so hard that it may be mis-
taken for a fibrous or other solid tumor.

**Acute Inflammation** of the bursæ may occur from local injuries, or some-
times it arises without any apparent cause; thus a bursa already enlarged
may, from its exposed condition, receive a blow, and become acutely in-
flamed; or the enlargement may result from an attack of acute inflammation.
The inflammation thus excited is not usually confined to the bursa, but in-
volves also the surrounding areolar tissue, and at times spreads even to the
joint.    The skin now becomes of a dusky red, the swelling gradually increases
from effusion into the bursa and also into the surrounding tissues, which are
edematous, the heat is marked, and the pain often great as the tension in-
creases.    If the inflammation continues, suppuration takes place, and the con-
stitutional symptoms of fever, which had existed throughout, become more
marked.

**Pathology.**—The pathology of enlarged bursæ may be comprehended at
a glance, as the enlargement is due chiefly to the chronic irritation or inflam-
mation of a synovial membrane, with increased secretion or effusion of serum
and lymph, and the consequent modifications of the action of a serous tissue.

**Treatment.**—The part should be kept at rest, astringent and anodyne
lotions should be applied, and if the symptoms are severe, leeches should
be employed.    The diet and condition of the bowels should be carefully
attended to, and the pain controlled by the administration of anodynes.
If suppuration takes place, the pus should be evacuated by a free incision.

### ₰ 1.—Ganglion.

**A Ganglion** is an enlargement of the carpal bursa, and presents the symp-
toms before detailed.    It may appear on any portion of the wrist, but is
most commonly met with on the back, and in the course of the tendon of the
indicator muscle, or in that of the extensor communis.

**Diagnosis.**—A careful examination of the mobility of the tumor, and the
evident presence of a liquid, renders the diagnosis easy.

**Pathology.**—The origin of the tumor is evidently a subacute inflammation
of the bursa caused by the excessive play of the tendon—the tumor being
most frequently seen in those who use the fingers constantly, as clerks or
workingmen.    The rice-like bodies, and those of odd shapes, are merely
unorganized masses of fibrin.

**Prognosis.**—The prognosis is favorable.

**Treatment.**—The treatment of ganglion consists in getting rid of the
contents of the sac, and this may be accomplished in two ways: 1. By such
means as are calculated to check the irritation and promote absorption, as

friction of iodine ointment; or the parts may be painted with the tincture of iodine, or still more powerfully by the application of the ioduretted collodion. This last is a more powerful counter-irritant than the tincture of iodine, and also acts by the constricting effect of the collodion. Pressure has also been recommended, though individual experience has led me to the opinion that all such means are but temporary, and that pressure, by causing inflammation, rather leads to the increase of the tumor. The best mode of treatment is, 2. To promote the evacuation of the contents of the sac by rupturing it with a blow, or by a subcutaneous puncture, when the sac having been opened, the fluid will escape into the surrounding areolar tissue and be afterward absorbed. But a less painful and more surgeon-like mode of producing the same result is by means of a subcutaneous puncture with some suitable narrow, sharp-pointed instrument, such as a tenotome, or a cataract needle.

This plan of operating has been objected to by some, on account of a vague fear lest inflammation of the joint might ensue. This has, indeed, resulted in a few cases in which the sac of the ganglion still communicated with the joint, and an attempt had been made to dissect it out. In order to learn if such a connection does exist, the cyst should be steadily pressed upon; if the tumor slowly disappears, and slowly returns when the pressure is removed, the ganglion evidently communicates with the joint. Sometimes under pressure the tumor will suddenly disappear, and as suddenly reappear; when this occurs, it is merely due to the cyst having slipped beneath some tendon, ligament, or an adjacent fibrous expansion.

If the simple evacuation of the fluid does not suffice for the cure, the sac may then be injected with tincture of iodine and water, in the proportion of one part to three,* as recommended for chronic arthritis.

### § 2.—Housemaid's Knee.

**Housemaid's Knee** is the name given to the disorder when the enlarged bursa is that of the tendon of the patella. This is a disease quite common in England, but much rarer in this country, where servant-girls use the scrubbing-brush with a long handle, instead of going upon the knee to use the hand-scrub; hence the disease is rarely seen in the United States, and when it is, is generally found among the natives of the British islands. When the disease occurs, it shows itself at first in the shape of a slight thickening or enlargement on the knee; but this soon becomes a tumor, which is sometimes flattened, though generally more or less spherical, and is seated just below the knee-joint, corresponding in situation with the position of the bursa, Fig. 372. It is not only a deformity from its appearance, but creates inconvenience by interfering with the action of the tendon, and preventing the proper flexion and extension of the leg. It has been known, moreover, to create such inflammation as to involve the knee joint secondarily.

Fig. 372.
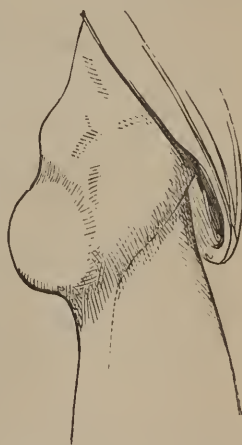


Enlarged Bursa over the Patella —Housemaid's Knee.

**Treatment.**—The treatment is to be conducted

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* Barwell, p. 359.

upon the same principle as that of ganglion, bearing in mind, however, the difference in the size of the tumors, this one requiring to be evacuated by a small trocar and canula, so as to draw off the fluid, when pressure may be made with a view of bringing into contact the sides of the sac, and causing them to adhere. Should, however, this plan fail, as it will very often do, and the tumor reappear, one of two plans may be resorted to.

1. An incision may be made, and the sac entirely dissected out, which should be carefully done, every means being taken to prevent the consequent inflammation from involving the knee-joint, while any portion of the sac that is adherent to the patella and left behind should be cauterized by the nitrate of silver, lest the tumor be reproduced.

2. The sac may be again evacuated, and its cavity injected with tincture of iodine, with a view of producing adhesive inflammation.

Recent cases, in which the walls of the sac are not yet much thickened, may be advantageously treated by blisters or other counter-irritants. *

Barwell states that he has frequently cured such tumors by passing a long-bladed tenotomy knife for some distance through the skin, and dividing the bursa as widely as possible subcutaneously of this bursal enlargement. †

### ₰ 3.—Femoral Bursa.

**Symptoms.**—When the bursa which exists in connection with the passage of the tendons of the glutei muscles over the trochanter major of the femur enlarges, the symptoms will be very much the same as those of the tumors just described ; but the dense nature of the structures covering this bursa gives to this tumor such a degree of firmness that it is often mistaken for one of the fibrous tumors which are not uncommon in this part.

**Diagnosis.**—A diagnosis, however, may generally be made from the presence of more or less obscure fluctuation, from the situation of the tumor corresponding with the normal position of the bursa, and, if all other means fail, by the use of the acupuncture needle.

**Treatment.**—The treatment is to be conducted upon the principles already laid down.

* Barwell, p, 344.                    † Ibid.

# PART XI.

## AFFECTIONS OF THE BLOOD-VESSELS.

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## CHAPTER I.

### ANEURISM.

THE term Aneurism—ανευρυνειν, to dilate or distend—is one which is applied to a tumor formed in consequence of the distention of the coats of a blood-vessel. This tumor may be created either spontaneously, by a dilatation of all the coats of the vessel, as the result of diseased action in the tissue, or by the mechanical rupture of its internal and middle coat and dilatation of its external layer; or by the rupture of all its coats and the formation of a tumor in the sheath of the vessel or in the surrounding cellular tissue. Though reported as a common disorder in New York, it is certainly quite rare in Philadelphia, and generally, I think, in most parts of the United States; as compared with other surgical affections.

Etiology.—The causes of aneurism may be grouped into two general classes—the predisposing and the immediate.

Among the *predisposing* causes may be mentioned the shape of the vessel, the points where it has a curvature being most apt to be affected. Old age is also a predisposing cause; and so are rheumatism and gout. So also the abuse of alcoholic drinks, old drunkards being said to be peculiarly predisposed; while sex has its influence, the disease being more common in the male than in the female sex, probably because man is exposed to more violent and continuous muscular exertion than woman. Various diseases in the coats of the vessels are also set down as predisposing causes, especially atheromatous or fatty deposit. This, according to Bennett, "presents the appearance of a whitish or yellowish cheesy substance, though sometimes indurated and brittle, as the calcareous degenerations generally, this being here deposited between the coats of the vessel and often protruding into it. The deposit consists of numerous fatty granules, mingled with crystals of cholesterine, which, when hard, also are mixed with calcareous amorphous salts."

Among the *immediate* or exciting causes of aneurism are wounds and injuries to the arteries, sprains, violent exertion, and mechanical injuries of all kinds.

Varieties.—For the purposes of methodical study, all aneurisms may be

divided into two principal classes—1, as *spontaneous*, and 2, *traumatic*, these being again subdivided in reference to their condition as *true* and *false aneurisms*. Some authors have made a more elaborate classification, but the simpler one just stated is amply sufficient to meet the study of the subject at present.

By a **True Aneurism** is meant one which is formed by the preternatural expansion of all the coats of the vessel itself, Fig. 373, while under the same head are also placed such tumors in the course of the arteries as consist in a dilatation of one or more of its coats, the other being entirely ruptured. Either of these varieties may occur spontaneously or be caused by wounds.

When the arterial coats are broken either by a wound or other external violence, or in consequence of disease, and the blood escapes into the sheath of the vessel or into the surrounding connective tissue, so as to form an aneurismal sac, this condition is placed in the second class and designated by the general name of *false aneurism*. Of these two classes there are some subdivisions which indicate the character, extent, and condition of the tumor. Thus, in true aneurism, when only a small portion of the length of the artery is enlarged, the tumor is designated as *circumscribed*, and this class of aneurisms are called circumscribed true aneurisms; but when only a portion of the artery is involved, the tumor is spoken of as a *diffused* true aneurism.

Fig. 373.



The Appearances of True Aneurism as formed by dilatation of all the Arterial Coats —fibrin having filled the Sac but left the Canal clear—showing how nature accomplishes a cure.

**False Aneurisms**, like the true, present also such varieties as are due to the extent of the disorder; thus, when the tumor is limited in its shape and involves but a portion of the limb, it is said to be circumscribed; but when the blood travels up and down the cellular substance of the part and forms a tumor of greater extent, the tumor is said to be diffused.

**Symptoms.**—There are certain symptoms which are created by aneurisms wherever found, whether true or false, the first of which are due to the action of the tumor itself. They are changes of action, form, and sensation in the part or other adjacent parts. Most frequently simple inspection of an aneurism will show that it pulsates distinctly, the elevation and depression of the surface consequent upon the pulsation being usually perceptible at some little distance. When examined by the touch it also usually gives an elastic sensation, and a pulsation that can be readily felt synchronously with the contraction of the heart, or has only such a variation as is consequent upon the time which it takes for the impulse of the heart to reach the tumor. Aneurismal tumors vary in size in accordance with the calibre of the vessel, the dilatation of the anterior tibial artery, for example, being sometimes not larger than a nut, while those of the larger vessels reach the size of an orange, or often larger. Another characteristic symptom of aneurisms is their diminution upon pressure,

whether applied upon the tumor itself or higher up along the course of the arterial trunk which supplies it, or upon the main trunk of the limb upon which it has its seat. This diminution is, however, more marked in true than in false aneurisms. When, in such a test, the pressure is entirely removed, the tumor usually rapidly resumes its original size, but in the event of the treatment of the disease by means of a continuous pressure, as will be presently explained, this dilatation does not supervene upon the removal of pressure.

Aneurisms often produce considerable local pain if so situated as to press upon the nerves of the part, the pain varying in character and degree according to the amount of pressure and the connections of the tumor with the affected nerve. The same pressure upon the local nerves which produces pain may also create various muscular phenomena, such as cramp, spasm, etc.

An aneurismal tumor is, however, usually free from pain, at least until it has attained such a size as to be painful from its mere tension. The skin over the tumor also remains for a long time unchanged, seldom presenting evidences of inflammation until the size of the tumor is such as to interfere with the capillary circulation; but when congestion supervenes, a train of symptoms ensue which are similar to those which were explained in connection with the subject of tumors. When congestion of the capillary vessels of the skin induces inflammation in this tissue, it soon induces ulceration and suppuration, or sloughing, by which the aneurismal sac is opened, and violent and often fatal hemorrhages follow.

As the tumor grows, its pulsation often diminishes, so that it is no longer noticeable at a distance, though the touch will still recognize it, even when quite feeble; at the same time the elastic character of the tumor diminishes, both these changes being due to changes within the tumor, which will be presently detailed.

Should the aneurism be so situated as to produce pressure upon any portion of the skeleton, absorption, or even caries of the bone, may ensue. Should the veins of the part be pressed upon, other well-marked symptoms will appear, and as the return of the blood to the heart will now be impeded, there will be more or less leakage of its watery portions into the cellular tissue beneath the skin, which will produce edema. Thus, for example, if the aneurism be situated in the iliac artery, and pressure is made by the tumor upon the iliac vein so as to impede the circulation in that vessel, edema of the lower extremities will be the result.

All aneurisms are liable to terminate in two ways, either by death or by cure, nature being capable, under some instances, of accomplishing a cure. When a cure is accomplished by nature, it is generally consequent upon changes within the sac, resulting from a deposition of lymph upon its walls, Fig 373; this deposition being the consequence of inflammatory action, or a change in the circulation of the blood in the sac, this resulting in a laminated fibrinous structure which gradually, and layer by layer, increases the thickness of the sac, until its cavity is closed. When the aneurism terminates fatally, it generally does so somewhat in the following manner: The aneurismal tumor grows larger and the sac thinner, owing to its constant distention from within, while the various structures between the tumor and the skin, gradually waste, and are removed by absorption, when the pressure encroaching upon the skin, ulceration occurs, or sloughing takes place, and the cavity of the sac being opened, Fig. 374, blood escapes with a sudden gush, and the patient dies generally upon the spot. But although this is a very common mode of termination, and although it may be stated in round numbers that nine out of ten of the cases

of aneurism terminating fatally perish by hemorrhage, yet this is by no means universally the case, as a sac may form within the aneurism, as in
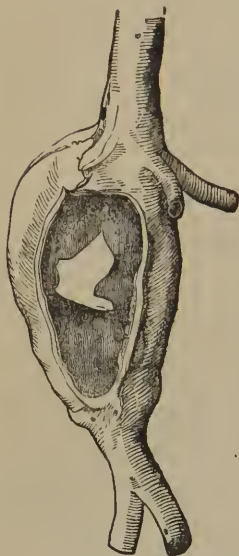
Fig. 374.                                                    Fig. 375.



Fig. 374.--A view of an Aneurism produced mainly by Dilatation that has burst, the patient having died suddenly.
Fig. 375.—Aneurism with a Double Cyst; the first having given way, the tumor became diffuse, but a second Cyst formed of the tissue around the artery.

Fig. 375.   Death may also ensue from pressure upon the neighboring viscera ; or it may be a consequence, in aneurism of the arch of the aorta, or indeed in aneurisms of the thoracic aorta generally, of pressure upon the thoracic duct, or on the heart and lungs, etc.

Fig. 376.
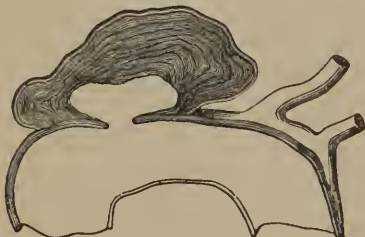


A diagram of a True Aneurism of the Arch of the Aorta, the greater part of the Sac being filled with a clot, and the aperture of communication small.

As might be expected from the nature of the disease, in every aneurism of considerable size various pathological changes result, not merely in the parts affected, but even in the vessels at a considerable distance from the seat of the tumor, besides which we have various diseased conditions that are the result of pressure upon the surrounding parts.

As regards the artery itself at the seat of the tumor, the aneurism may be formed by a uniform dilatation of all the coats, this being the simplest and most common variety of what are called true aneurisms, while in an-

other variety, as described by Breschet, of Paris, the dilatation involved merely the external and internal coats, the middle coat being entirely torn.

In a third variety, the external and middle coat having given way, the internal coat protruded so as to form the tumor; though from the delicacy of this coat it will readily be perceived that this form must be exceedingly rare.

A much more common form consists in rupture of the internal and middle coat, while the external is so distended as to form the tumor.

**Diagnosis.**—In diagnosticating an aneurism, the surgeon will be guided by the fact that there is a round or ovoid tumor on or near the course of an artery, which is elastic and pulsates, the pulsation disappearing more or less perfectly under pressure on the main trunk of the artery near the heart. Auscultation will also afford him admirable aid in attaining his diagnosis; as upon putting the ear upon the tumor, two varieties of sound will be perceived—the *bruit de soufflet*, or bellows murmur, and the *bruit de râpe*, or the rasping or sawing sound; besides which the peculiar aneurismal thrill or *whirr* will be perceived, the latter being also recognizable by means of the touch.

The diagnosis between true and false aneurism is sometimes of importance, especially in regard to the treatment. Among the means by which it is to be made, not the least important is the history of the case. Thus, if the patient states that the tumor supervened upon violent muscular action and rapidly assumed the aneurismal characteristics, the surgeon might fairly be led to suspect a false aneurism; if, on the contrary, the tumor appeared gradually without any injury or violence done to the part, and especially if the age of the patient is such as would lead one to suspect those diseases, as calcareous or atheromatous degeneration, which act as predisposing causes, he might reasonably regard the disease as a true aneurism. In making the diagnosis, therefore, the history of the case becomes of great importance.

The surgeon will also be much aided in his diagnosis by a careful examination of the tumor itself, as such an examination will often reveal several points of importance. For example, if the position and size of the vessel are such as to expose it to violent muscular action, it would be peculiarly liable to suffer from false aneurism, as in aneurisms of the popliteal artery, which are often the result of violence; while, on the contrary, in aneurisms found in connection with the arch of the aorta, with the innominata, or with the thoracic aorta, etc. which involve vessels not exposed to muscular or other violence, a true aneurism will, as a general rule, be found. The depth of the vessel will also aid in the diagnosis, and, upon the same general principle, the artery least exposed to violence will be the least likely to suffer from false aneurism. But the best and most accurate mode of diagnosis between these two varieties is to be found in the effects of pressure upon the tumor. If the aneurism be a true one, and especially if it be seen soon after its formation, it will be observed that pressure made over the course of the affected artery between the tumor and the heart will diminish to a greater or less extent the size of the tumor very promptly, as the pressure upon the vessel cuts off the supply of blood and thus causes the collapse of the aneurismal sac, and a diminution in the size of the tumor. This collapse of the tumor depends, however, somewhat on the thickness attained by the walls of the sac, as old aneurisms with a sac very much thickened will collapse less perfectly than others which are more flexible.

Pressure applied in precisely the same way over the vessel supplying a false aneurism does not, however, act with the same promptitude, because of the greater disposition in the false aneurism to the formation of clots,

which, by blocking up the sac, prevent its collapse when the supply of blood is cut off.

Apparent pulsation in the tumor is, however, liable to lead to grave errors. If, as has been before stated, a solid or firm tumor should be seated over the course of an artery, and bound down to it by fibrinous or muscular expansions, pulsation may apparently be perceived in the tumor, and yet be caused solely by the proximity of the vessels; but if such a tumor be drawn to one side, or the muscles be relaxed by change of position, then the pulsation will cease, which is not the case in aneurisms. The diagnosis in these cases is, however, often one of great difficulty, and many instances have been recorded where the most experienced surgeons have been mistaken. Several years since, I saw in the Blockley Hospital, Philadelphia, a large abscess in the iliac region pulsate so as to simulate an aneurism, and the difficulty of diagnosticating it was so great that an eminent surgeon spoke of it as a decided example of vascular enlargement.

In all cases of doubt, palliative measures alone should be resorted to until the character of the complaint can be more positively established. But if delay does not elucidate the case, and the pain and other urgent symptoms require a prompt decision, the practice of Guattani may be repeated, and an exploratory puncture made, the hemorrhage, if it be an aneurism, being arrested by pressure. The opening of the aneurismal sac, under these circumstances, has not, however, been attended by the serious results that might at first be anticipated. Several instances of its having been done, in a more extensive manner, without causing serious difficulty, have been mentioned by surgical writers, among which is one by Rhea Barton, of Philadelphia,* where an empiric plunged a lancet into the tumor, under the supposition that the disease was an abscess. Fainting arresting the hemorrhage at the time, the patient lived six weeks, and afterward died of mortification of the limb; when, on a *post-mortem* examination, the inguinal tumor and femoral artery were found in such a condition that Barton expressed the opinion "that, if the patient (aged seventy years) had had a little more vigor of constitution, the opening of the aneurismal tumor would have cured the complaint." Lest, however, such fortunate results should not always ensue, it will be safer for the surgeon, when compelled thus to test the character of the tumor, to be prepared to ligate the main trunk of the artery immediately.

Prognosis.—The prognosis in the case of aneurism is generally serious, and should always be guarded. As a general rule, it may be set down that an aneurism will terminate fatally if left to nature, though this is not invariably the case, while the time which may elapse between the first formation of the tumor and its fatal issue will vary considerably, depending upon the position of the aneurism, the constitution of the patient, etc. The prognosis as regards operations should also be made guardedly; often they are successful, but very often also they fail, and no positive prognosis can be made except in traumatic aneurisms.

Treatment.—In carrying out the constitutional treatment of aneurisms, the surgeon should pay attention to the state of the general circulation; this being so regulated as to diminish the force of the heart and reduce the current of blood through the part, in order that we may thus favor the formation of a clot. In other words, the treatment of Valsalva should be carried out, the patient being kept at perfect rest, while the tincture of digitalis, veratrum viride, or aconite is given to diminish the heart's action. With this view the strong tincture of the root of aconite (Fleming's tinc-

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* Philad. Journ. of Med. and Phys. Sciences, vol. i. N. S. p. 127.

ture) may be employed in the dose of one drop at first, and gradually increased, if the patient seems to bear it, to two, three, four, or even five drops twice a day, or the tincture of veratrum viride may be similarly administered, the effects of the remedy in each case being carefully watched. Low diet, by its modifying influence over the action of the heart, may also be expected to prove useful in the general treatment, and so will occasional bleeding. But in blood-letting for aneurism, and especially in aneurism situated near the heart, care should be taken not to carry the abstraction of blood too far at one time, lest the heart's action being once suspended in syncope, it never return. But though very plausible, Valsalva's plan has not been followed by general success, and Boyer, Sir A. Cooper, Roux, Bennett and others speak disparagingly of it.

The local treatment of the palliative kind should consist in the application of cold and astringents. The cold, which acts by diminishing the circulation in the tumor, should be applied in the shape of bladders filled with pounded ice; or cloths wet with cold water, combined with astringents, may in aneurisms of the extremities be employed. But little permanent benefit can be expected from such external applications, and they are only of service when an aneurism which cannot be tied threatens to burst; in such a case, life may possibly be prolonged for a few days. Pressure upon the tumor, or upon the artery supplying the tumor, is, however, a very important means not only in the palliative, but in the radical treatment. This pressure has for its object the diminution of the circulation through the sac to such an extent as to cause it to be filled up rapidly by the concentric laminæ of lymph already alluded to; but it should be borne in mind that the object of the pressure is merely to *diminish* the circulation through the sac, *not to interrupt* it altogether.

Pressure may be applied in the treatment of aneurisms in various ways. One manner is that which is spoken of as Guattani's method, from the name of the surgeon by whom it was first carried out, in which the whole limb is bandaged, graduated compresses being first suitably applied over the tumor and the course of the vessel supplying it.

There are, however, serious objections to this plan of treatment, as it is difficult, if not impossible, to apply such a bandage with sufficient firmness to have any efficacy in the treatment of the complaint without interrupting the circulation in the veins of the limbs. There are, moreover, few persons who can so accurately apply a bandage as to avoid making unequal pressure upon some one point, thus inducing neuralgic pains, edema, etc.; and as it has been found a doubtful plan of treatment so far as the results of cases were concerned, it has been very generally abandoned.

Compression, as a remedial agent in the treatment of aneurism, has, however, been revived, though in a modified form, Fig. 377, by the Irish practitioners, and particularly by Bellingham, of Dublin. This surgeon applies pressure in the course of the vessel, but so as only partly to interrupt the circulation through the tumor, making the pressure sometimes upon the tumor itself, but most generally at some little distance from the sac, upon the artery supplying the tumor, and between it and the heart, in precisely the same

Fig. 377.
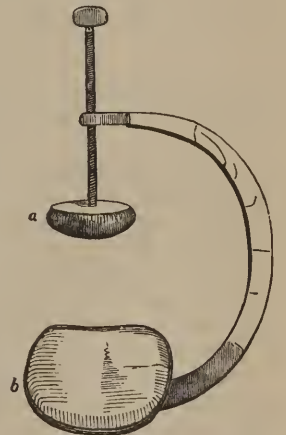
BELLINGHAM'S CLAMP.—*a.* Compress for the artery. *b.* Point of counterpressure.

relative position that Hunter suggested the ligation of the artery for aneurism.

That the various modes of exercising pressure may be understood, it may be mentioned, in this place, though somewhat in advance of the subject, that Hunter suggested the ligature of the artery upon its sound structure at some little distance from the aneurismal sac, and between the tumor and the heart, and that it is on precisely the same principle that compression is to be applied, the femoral artery being compressed in the treatment of popliteal aneurism, etc., Fig. 378, H.

Brasdor, on the other hand, applied his ligature on the distal side of the artery affected, Fig. 378, B.   And so, also, may pressure be applied particularly in those cases in which it would be impossible to apply it between the heart and the tumor, and it will be readily understood that the circulation being thus cut off on the distal side of the tumor by pressure, a clot will form, and by its organization radically cure the aneurism.

Fig. 378.
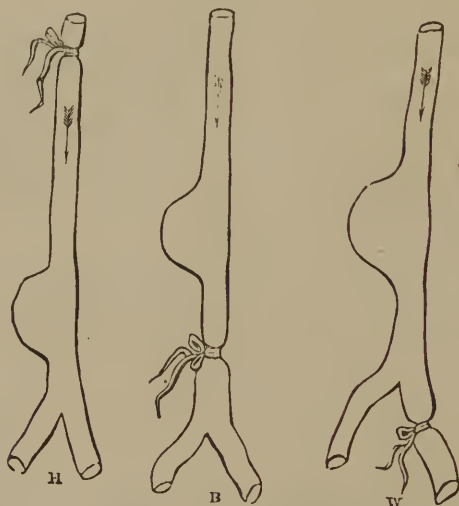


A diagram of Hunter's, Brasdor's, and Wardrop's Operations for the cure of Aneurism, compression being capable of acting at similar points.

Another modification of the seat of the ligature was that of Wardrop, Fig. 378, W, who, when an aneurism existed upon a vessel which afterward branched, applied his ligature to one of the branches on the distal side, expecting, by thus partially diminishing the circulation, to favor the formation of a clot.   Thus, in an aneurism of the primitive iliac, Wardrop tied the external iliac, leaving the internal untouched; and pressure may be applied upon this principle also, but not with such hopes of success as in the former methods.

The most successful mode of making pressure is, however, to make it between the tumor and the heart, with which pressure upon the tumor itself may advantageously be combined.

The means by which pressure upon the course of the vessel supplying the tumor can be effected, without checking the circulation through the whole limb, are various; one is through a tourniquet, which consists of two pads fixed upon shanks of steel, that are made to approximate each other by means of a screw, an instrument to which attention has recently been invited

in the New England States, and which has been spoken of as a new invention, but which really is very old, and was formerly described as Signoroni's tourniquet. This instrument, however, by its unvarying pressure upon a single point, is very apt to give such pain that it can seldom be borne.

A much better plan of effecting this pressure is by means of the instrument which has been above described as Bellingham's compressor, Fig. 377, an instrument which has proved so useful that, out of thirty-nine cases of aneurism treated by means of it, thirty were cured. I have employed this instrument with such success that, in every case of aneurism to which compression was applicable, I would try it before resorting to so extreme a measure as the ligation of the artery—an operation which, in some cases, cannot be regarded as justifiable until compression had been tried.

In compressing, say the femoral artery for the relief of popliteal aneurism, by means of Bellingham's plan, two instruments are necessary, each consisting of a steel band, having at one extremity a pad, to compress the artery, which can be tightened by means of a screw, and, at the other, a larger pad, to act as a support, these instruments being placed upon the thigh so that they can be made to act alternately, the second being tightened as the first becomes painful, and the first then relaxed so as to keep up a uniform interruption of the current in the vessel; but *the compression should never be violent enough to entirely interrupt the current of the blood, but merely to modify and diminish it.* This pressure requires, if any success is to be derived from it, to be patiently persevered in from ten to twenty days.

Another form of compression, and one which is suitable to the brachial artery, is that made by a spring which is connected with a strap so as to buckle around the limb, while the pad is capable of being pressed upon the artery by means of a screw. It is applied in the same manner as the clamp of Bellingham.

Pressure made upon the aneurismal tumor by this plan accomplishes a cure by effecting the same changes as are created by nature; the circulation being diminished in force, not sufficiently to destroy the life of the limb, but enough to favor to the fullest extent the formation within the sac of the lamellated fibrin already alluded to. Another advantage of the treatment by compression is, that it involves little risk, may be made therefore by the most timid practitioner, and, if unsuccessful, does not interfere materially with subsequent operative measures.

As the success of the treatment of aneurism by compression will depend very much upon the judgment that is shown in applying the force, it should always be borne in mind that the correct plan is to employ it so as to *diminish* the circulation without *interrupting* it, the pressure being at all times judiciously graduated with a view to this object. It should, moreover, be recollected that continued pressure upon one point, even when slight, will endanger sloughing, and that this may take place to such an extent as greatly to complicate the case. The local symptoms supervening on the application of pressure should, therefore, be carefully watched, and the compression, when it becomes painful at one spot, be replaced by pressure at other. Pressure may also be applied by the thumbs of a series of assistants, who are relieved from time to time, but not so advantageously, in most instances, as by instruments.

In attempting the cure of an aneurism by means of compression, it is important to remember that during the entire course of treatment the limb should be kept in the horizontal position, and neatly bandaged from the extremity upward, so as to guard against edema or inflammation of the skin. It is also essential to success that the pressure should be applied *very gradually,* as it is sufficient to *moderate the circulation without obstructing it.*

Unless thus conducted, compression will not only fail to cure the complaint, but also be likely to induce sloughing of the parts at the seat of pressure, or even gangrene of the limb. When judiciously employed, this treatment has often been followed by the most favorable results, having checked all pulsation in a tumor in ten days, though it usually requires a much longer time, amounting sometimes to six weeks. The success of compression, especially in the treatment of femoral and popliteal aneurism, has been decidedly great. In the paper on statistics, etc. by Geo. W. Norris, of Philadelphia,* it is shown that out of thirty-seven cases thus treated, thirty-five were cured, one dying of disease of the heart, and one being ligated ; while in two hundred and four cases treated by the ligature (Hunterian method) fifty died, and six were compelled to submit to amputation of the limb. In one case of aneurism of the popliteal artery, I obtained a cure in twenty-two days, and in four weeks in another case, in the bend of the arm, where the tumor was as large as an egg. A reference to the Bibliographical Index of the Ligature of Arteries, vol. ii., will show other cases.

The next plan of treatment is the application of the ligature, which, in its effects upon a diseased vessel, is the same as has been already described in connection with the ligation of a sound artery in a wound. It is not necessary to repeat, in this place, what was said upon the action of the ligature in the arrest of hemorrhage from wounds, (see page 192,) and these remarks will, therefore, be limited to such points as have not been previously mentioned, and have an immediate bearing upon the subject of aneurisms.

In old times, when the action of a ligature on a sound artery was very imperfectly understood, surgeons performed operations which were based upon peculiar views, great anxiety existing lest the ligature should not come away, its removal being supposed to be the result of the softening of its substance. But in the diseased artery, and especially in aneurismal dilatation, they rather feared its cutting through the vessel too quickly. Thus Scarpa used a broad ligature, surrounding the vessel first with a little cylinder of waxed linen or muslin, to prevent it from coming off too soon, and over this he tied his ligature, but not tightly enough to cut through the middle and internal coats.

Now there are cases—as when an aneurismal tumor is at the same time complicated with ossification of the artery—in which it may be advantageous to resort to Scarpa's method, lest from the diseased condition of the arterial coats the ligature should come away before the clot is sufficiently firm, in consequence of which troublesome secondary hemorrhage may result. But a serious objection to his mode of operating will be found in the fact that not unfrequently the internal coat is not sufficiently compressed to produce adhesive inflammation, and the external coat, moreover, is a very long time in ulcerating through ; the ligature, therefore, takes weeks to separate ; while, except in the case of disease in the arterial coats, the risks of secondary hemorrhage will rather be increased than diminished by this plan of treatment.

Another mode of applying the ligature in the treatment of aneurism was that of the old Greek and Roman surgeons—a plan which sprung from the fear which they entertained, and which we at the present day know to be erroneous in many instances, that putrefaction might be set up in the cavity of the sac, after the interruption of the circulation through it. Accordingly, it was their custom to ligate the diseased artery, both above and below the sac, after which they laid the sac open, and, turning out its contents, removed

the clots, sometimes even applying to it the hot iron. By this plan, how-
ever, and especially by the application of the cautery, the danger of second-
ary hemorrhage was infinitely increased; and as we now know how unneces-
sary was the fear of putrefaction in the contents of the sac, few surgeons at
the present day think, as a general rule, of laying open the sac, and incur-
ring the consequent dangers of suppuration, suppurative phlebitis, or the
occurrence of secondary hemorrhage.

Hunter, in England, who was about the first to modify the old operation,
acted upon a different principle; his ligature being applied to the sound
part of the artery, at a considerable distance from the
tumor, and between it and the heart, his object being to
cut off the current from the seat of the disease, by inter-
rupting the circulation through the main arterial trunk
supplying the tumor. In this manner, the supply of blood
being taken from the aneurism, the sac collapsed, its walls
adhered, and the tumor was gradually obliterated, the
artery beneath the seat of the ligature remaining as a solid
cord, while the clot behind the ligature, between it and
the heart, rose as high as the next anastomosing branch.
Meanwhile, as the circulation through the tumor was cut
off, that through the limb was carried on by means of the
anastomosing branches, Fig. 379. The principles ad-
vanced by Hunter, in his mode of operating, are those
now generally recognized as correct in all operations for
the ligation of arteries, when required by aneurisms or
wounds, and, when properly applied, induce a diminution
or cessation of the circulation in the main trunk, and an in-
crease of that in the anastomosing branches, the enlarge-
ment of the anastomosing branches, after the application
of the ligature, securing to the limb its proper supply of
the vital fluid, and preventing mortification.

The effects of this new course in the circulation are
easily shown in any large artery. Thus, if a ligature be
applied to the external iliac artery, the blood can no
longer pass through the femoral to supply the limb; the
vitality of the parts below the ligature is, therefore, at
once diminished, as is shown by a diminution in the tem-
perature, and in the sensation of the part, though both
are merely temporary, as, after a few hours, the natural
heat of the limb is restored, or it may even rise above the
healthy standard, in consequence of the rapid enlarge-
ment of the anastomosing branches, and the irritation
created by the operation. The anastomosing branches,
which enlarge to restore the circulation in the limb, vary,
of course, with the artery that is tied; but in the case of
the iliac artery, they would be the external mammary
and epigastric, with the various connections between
the branches of the internal iliac and the femoral on the
back of the thigh.

Brasdor's Operation for aneurism, as has been already
alluded to in connection with the subject of pressure,
differs from Hunter's in principle, the ligature being applied on the distal
side of the tumor, in consequence of which the blood accumulates in the
aneurism, and a clot is formed that fills the whole sac, and rises as high as

Fig, 379.
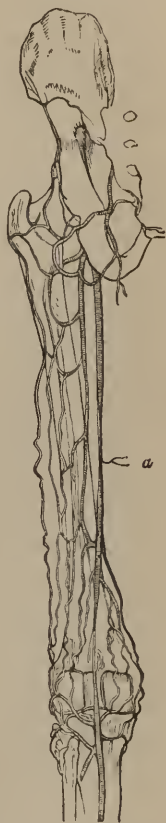


A view of the Enlarge-
ment of the Anastomo-
sing Vessels, showing
how the collateral cir-
culation is carried on
after the application of
a ligature.— a. Point
where the femoral
artery has been ligated.

the first anastomosing branch.  Now, there are cases where this is the only operation applicable, or indeed justifiable ; take, for example, an aneurism of the arteria innominata, the application of the ligature being here a difficult operation, and one which every surgeon would not be able to accomplish, while its fatal results are well known.    In this instance Brasdor's operation would prove particularly useful.

It sometimes happens that there are two arterial branches given off from the distal side of the aneurismal sac, the enlargement occurring, for example, at the very point at which the artery branches.    In such a case, should one of the two branches happen to be an anastomosing branch, it may follow that, after the performance of Hunter's operation, pulsation will be observed to recur in the tumor, if another ligature is not applied on the second branch.

**After-Treatment.**—The after-treatment of the wound made in these operations is that of all operations involving the ligation of blood-vessels, viz., to cut off one end of the ligature, while the other is left attached to the vessel, so that it will hang out at one angle of the wound.    This angle should also be kept open by a strip of lint, so as to favor the free escape of pus, while the rest of the wound should be healed as much as possible by the first intention.

When the circulation through a main blood-vessel is thus checked by the application of a ligature, various changes will ensue, and demand careful attention, the first of which is the loss of vitality in the part which derives its blood from the vessel operated on ; the second, the evils that sometimes result from the diseased condition of the vessel at the seat of the ligature ; third, failure of the operation to cure from inflammation and sloughing of the sac ; and fourth, from the return of the circulation into the aneurism through the enlarged anastomosing vessels.

1. Loss of vitality, or gangrene of a limb, may ensue on the application of a ligature to the main artery, in consequence of the tardy dilatation of the anastomosing branches.    Hence a diminution of temperature usually soon follows the application of a ligature under these circumstances, and should be counteracted by artificial warmth, the limb being closely enveloped in carded wool or cotton, and surrounded with bottles of warm water; or gentle friction practiced to prevent venous congestion.    When, after a period that varies from one to several hours, an increase of heat is noticed, the reaction may become so active as to develop inflammatory action, and thus lead to gangrene.    To avoid either result, demands therefore attention to such general principles as have been already alluded to in connection with humid gangrene.

2. Hemorrhage from the wound made by ligating an artery may either follow promptly on the application of the ligature, in consequence of the diseased condition of the arterial coats inducing their prompt division when the ligature is tightened, or ensue when the ligature is separated from the vessel by ulcerative action, or at any time after its separation before the wound has healed.    Too much watchfulness cannot, therefore, be employed to obviate this evil, and especially in preventing any indiscretion of diet or exercise on the part of the patient.    When secondary hemorrhage supervenes, pressure should be promptly applied to the vessel, and the wound packed, so as to favor the formation of a clot.    If this does not arrest it, the vessel should be ligated at some higher point if possible.

3. Inflammation and suppuration of the sac after the application of a ligature, may come on at various periods, but usually after the second week. When, from the heat, redness, and other signs of inflammation in the tumor, it is evident that suppuration has commenced, the best treatment is to com-

press the main trunk, and then, freely laying open the sac, treat it like an ordinary abscess until it fills up by granulation. Free hemorrhage from the distal surface of the sac through the anastomosing branches may, however, be expected, and require the application of a second ligature on the distal side of the tumor.

4. When the aneurismal tumor is reproduced through the enlarged anastomotic vessels, as is occasionally seen, a second operation, and the application of a ligature above and below the sac, may become necessary.

The cure of aneurism has also been recently attempted by manipulation, as suggested by Fergusson, of London, the tumor being so compressed and pinched with the thumb and fingers as to break up a portion of the fibrinous clot, a particle of which being carried forward by the force of the circulation is expected to plug up the main channel, and thus induce gradual solidification of the sac. The operation has occasionally, it is said, succeeded; but is liable to the objection of danger from the development of inflammation in the sac, and its subsequent ulceration, while the stoppage of the artery by the plug of fibrin is a hap-hazard result.

The coagulation of the blood in the aneurismal sac, by passing through it a galvanic current by means of acupuncturation needles, was advised, in 1832, by Phillips, of England, and practiced to some extent by Bonnet, of Lyons. It was performed as follows :—

Two acupuncture needles, varnished so as to prevent their rusting, should be introduced into the sac on opposite sides, so that their points may touch the circulation in the vessel, being at the same time diminished by pressure above the tumor, or between it and the heart. Then pass a gentle galvanic current through the needles, by connecting them with the poles of a battery, and continue it for a few minutes if the patient can bear the pain.

That such a plan is liable to serious objection, cannot be doubted, and there is yet not sufficient experience—though now thirty years old—in its published result to justify its substitution for the safer and more certain operations of compression and the ligature. The injection of the aneurismal sac with a solution of the perchloride of iron, introduced through a puncture by means of a syringe—it being hoped that the solution would stay where it was placed, and not pass into the general circulation, or, at least, not reach the heart—is another of the novelties proposed recently as a substitute for an operation long tested as a scientific one. Its repetition in the United States will probably lead the operator into a court of justice.

As aneurisms of the aorta, in any portion of its course, cannot be the subject of ligation, the duty of the surgeon must be confined to such a treatment as will delay an event which he has no power to prevent. The great indications are to diminish the force and frequency of the heart's action. All mental excitement is, therefore, to be carefully avoided, and all physical exertion calculated to quicken the circulation, shunned. The therapeutical agents best suited to calm the action of the heart is the tincture of veratrum viride, or the tincture of digitalis. Should there be paroxyms of pain, the latter may be associated with camphor water or morphia, or the ammoniated tincture of valerian. Or if the pulsation be very strong, accompanied with excitement of the circulation, blood may be extracted from the arm. The diet should be of the solid kind, such as meat, bread with butter, and a moderate amount of milk, all kinds of arterial stimulants being carefully avoided.

## SECTION I.

### ANEURISM OF THE ARTERIA INNOMINATA.

Aneurism of this large artery generally appears after the age of thirty years, and produces a great variety of phenomena in consequence of the important relations of the vessel.

**Symptoms.**—In addition to the general symptoms of a disturbance of the circulation, we shall find, as soon as the tumor has attained any magnitude, that it may be felt by pressing immediately beneath the right sterno-clavicular articulation, where the artery is covered in by the sterno-mastoid, sterno-hyoid, and thyroid muscles. As the aneurism increases, these muscles are pushed forward, the natural contour of the neck being gradually effaced, and a marked prominence taking the place of the usual fossa, just above the sternum, in which situation the pulsation may be both felt and seen, and the peculiar aneurismal thrill heard. Should the tumor be developed both toward the thorax and neck, the clavicle may be greatly displaced at its sternal articulation; should it encroach on the trachea and œsophagus, there will be dyspnœa and dysphagia; if it subjects the parts on the humeral side of the root of the neck to pressure, there will be cough and embarrassed respiration, from the effect of such pressure on the pneumogastric and phrenic nerves; and if it extend still more outward, there will be pain and numbness along the side of the neck and arm, from its contiguity to the brachial and cervical nerves. The bones against which the tumor throbs, such as the ribs, sternum, or clavicle, are also liable to become involved by caries.

**Prognosis.**—The prognosis in aneurism of the innominata is, as a matter of course, unfavorable, the disease advancing with great certainty, though sometimes slowly, to a fatal termination.

**Treatment.**—The ligation of the arteria innominata, on the cardiac side of the tumor, is probably not justifiable, the shortness of the vessel rendering such a proceeding unpromising, and every case operated on having succumbed. (See vol. ii.) There is, however, a sufficient amount of evidence to be drawn from recorded cases to justify ligation after the method of Brasdor. On this principle the carotid or subclavian, and sometimes both, have been tied by surgeons in this country and abroad with marked beneficial results, diminishing very much, in some cases, the bulk of the tumor, and entirely removing it in others by the changes induced in the contents of the sac. Whether an operation be performed or not, the circulation should be carefully looked after, and all violent action of the heart restrained by the timely exhibition of appropriate arterial sedatives, such as digitalis, the tincture of veratrum viride, opium or some of its preparations, the patient and his friends being warned against the danger likely to ensue on all physical exertion or mental excitement.

## SECTION II.

### ANEURISM OF THE SUBCLAVIAN ARTERY.

**Aneurism of the Subclavian Artery** may affect any portion of the vessel, though, in consequence of the third portion, or that between the scalenus medius muscle and the first rib having but little support, the enlargement appears most frequently to involve this part.

**Symptoms.**—The symptoms of subclavian aneurism are, for the most part, tolerably well defined, as a tumor may be easily detected, especially if the outer part of the artery be involved, even before it has attained any considerable magnitude. As the tumor increases in size, the hollow space immediately above the clavicle begins to disappear, especially when the disease is developed toward the surface. Should it commence, however, on the inner side of the scalenus anticus muscle, it may escape detection some time, owing to the clavicular attachment of the sterno-cleido-mastoid muscle being in front. The tumor may be round or elongated, or bi-lobed in shape ; the latter form being caused by the artery yielding on either side of the scalenus anticus muscle. Pain is almost always present, even at an early stage of the disease. The bellows murmur may be recognized by the ear, and more or less serous infiltration of the connective tissue of the neck will be present, the result of embarrassed venous circulation. Various other symptoms may present themselves as the disease advances, the character of which will depend on the direction and rapidity of increase ; such, for example, as those which follow from inflammatory thickening and gluing together of the surrounding tissues, pleuritis, or difficulty of respiration from pressure upon the summit of the lung, pain and numbness of the arm due to injury sustained by the brachial plexus of nerves, etc.

**Diagnosis.**—From aneurism of the innominata, subclavian aneurism may be distinguished with tolerable clearness, the latter being more toward the median line of the neck, and producing, at a comparatively early period, difficulty both in deglutition and respiration, from its close proximity to the œsophagus and trachea.

**Prognosis.**—The prognosis in subclavian aneurism is exceedingly unfavorable. Occasionally a spontaneous cure occurs ; but the usual progress of such cases is to gradually increase, often removing portions of the ribs or clavicle by absorption, until the sac, either by ulceration or extreme distention, gives way, and the patient expires rapidly from hemorrhage.

**Treatment.**— The radical cure of a subclavian aneurism can only be effected by an operation, the result of which is doubtful. (See vol. ii.)

A moderate and solid diet, with the avoidance of any considerable physical exertion, will be the best suited to a patient laboring under this affection.

## SECTION III.

### ANEURISM OF THE AXILLARY ARTERY.

**Symptoms.**—In consequence of the close relation between the axillary artery and the axillary plexus of nerves, it might be anticipated that among the earliest evidences of an aneurism of this vessel would be an alteration in the sensibility and an abridgment of power in the arm. This is true. As the tumor enlarges, which it generally does rapidly, it may be clearly distinguished by the fingers pressed into the axilla beneath the pectoralis major muscle, or, if it is developed upward, in the triangular space just below the clavicle, bounded on the one side by the deltoid, and on the other by the clavicular part of the pectoralis major muscle, the pulsation will become quite noticeable and the thrill be heard by the stethoscope. The arm also becomes very painful and edematous, and there is almost entire loss of power.

**Diagnosis.**—It is possible that an axillary aneurism may be mistaken for other growths, such as disease of the lymphatic glands, so abundant in this region; yet a careful examination would very soon correct such an error.

In enlargements of the lymphatic glands, either from carcinomatous degeneration or other causes, the tumor is usually found to be more irregular and dense than an aneurism, is probably more movable, furnishes no thrill, is not diminished by pressure on the subclavian above the clavicle, and generally inflicts less lameness on the extremity. Axillary abscess, when handled, may impart some sensation similar to aneurism, but there will be absence of pulsation, as the loose texture of the axilla admits of the matter diffusing itself without being firmly confined about the artery. The loss of movement in the arm bears a comparatively small proportion to the pain and bulk of the tumor. Rigors are more marked in abscess than in aneurism; the progress of the latter is more rapid, while there will be inflammation and discoloration of the skin in the axilla, when the pus is fully formed.

**Treatment.**—Surgical interference should be early adopted in axillary aneurism. The disease, if left to itself, may produce immense destruction of the adjoining tissues, displacing the shoulder by passing beneath the clavicle or scapula, or, removing the ribs, extend into the thoracic cavity, and in almost any case tending rapidly to a fatal issue by hemorrhage. A ligature should be applied upon the subclavian artery. (See vol. ii.) Nearly one-half of those so treated, as far as statistical data determine, have been found to recover.

## SECTION IV.

### ANEURISM OF THE BRACHIAL ARTERY.

**Aneurism of the Brachial Artery** is caused, in most cases, by the ignorant employment of the lancet, or results from wounds. Such accidents have given rise to the common names varicose aneurism and aneurismal varix; neither of which is very significant. Should the vein be transfixed, and the artery punctured, the two may become bound together by the resulting inflammation, and the arterial blood flow into the vein, thus creating "the *aneurismal varix.*" Or if the blood should flow into the intervening tissue, separating the two vessels, and form an intermediate sac, into which both arterial and venous blood will flow, we shall have the so-called *varicose aneurism*, as will be again explained.

**Treatment.**—Pressure, accurately and carefully applied above and below the tumor, may occasionally succeed in effecting a cure; but the ligature applied to the brachial artery, both above and below the disease, will prove more certain.

## SECTION V.

### ANEURISM OF THE RADIAL AND ULNAR ARTERIES.

When either the radial or ulnar arteries become the seat of aneurism, the appropriate course to adopt is to ligate the vessel on both the cardiac and distal side of the tumor. This is rendered necessary in consequence of the free communication existing between the vessels of the forearm.

The terminal branches of the radial and ulnar arteries in the hand form a remarkable chain of inosculation, and render penetrating wounds in this region often extremely troublesome, a fact which should be recollected in all attempts at checking the circulation for disease of the radial or ulnar arteries.

## SECTION VI.

### ANEURISM OF THE PRIMITIVE CAROTID ARTERY.

**Aneurism of the Primitive Carotid** may occur at any point in the course of this vessel.

**Symptoms.**—The tumor may attain some bulk before the patient's attention will be particularly called to its existence, and may even be overlooked by the medical attendant, unless conversant with such disease, regarding it merely as a ganglionic enlargement. When it attains some size, the patient will generally experience pain on that side of the head, and more or less unpleasant sensations, which are referred to parts deep within the cranium. As it is placed in close contiguity with the internal jugular vein and pneumogastric nerve, it is accompanied also with symptoms of cerebral congestion and bronchial irritation, especially after the tumor has attained some considerable magnitude. The pulsation and thrill, together with the effect of pressure on the cardiac side of the tumor, in diminishing its volume and movement, will further serve to designate its true character.

**Diagnosis.**—There is a possibility that aneurism of the carotid might be confounded with growths of a very different character, such as enlargement of the thyroid body, or some of the lymphatic ganglions. The following considerations will serve to distinguish it from the former. Goitre is almost exclusively a disease of females, while aneurism is only so in a very limited degree; in goitre the tumor is very often symmetrical, that is, both lobes of the thyroid gland are involved, while aneurism of both carotids is very rare.

The thyroid body has such anatomical connections with the trachea that in deglutition, even in a goitre, it will rise and fall with the movements of that organ, but no such result will be witnessed if the tumor be connected with the artery.

In distinguishing such an aneurism from enlarged lymphatic glands, a string of which is intimately related to the sheath of the cervical vessels, we are to take into account the diathesis and age of the patient, and the conformation of the mouth. Lymphatic enlargements are most common in young subjects of a scrofulous organization, usually irregular on their surface, and may be so manipulated as to satisfy the surgeon that any signs of movement they may have exhibited are the result of a transmitted impulse from a contiguous vessel, and not from a force within. Too great care cannot be exercised in dealing with tumors in the cervical region, as it has occurred that even eminent surgeons have committed serious errors.

**Treatment.**—The only course which can be adopted with any prospect of success is ligation of the artery on the cardiac side of the tumor. When this is not practicable, in consequence of the aneurismal tumor being low down close to the origin of the artery, it is a matter of doubt whether it be worth while to subject the patient to the alternative of tying the innominata, or of including the external and internal carotids in ligatures.

Should an aneurism involve the external or internal carotid artery, the appropriate course will be to ligate the common carotid. (See vol. ii.)

## SECTION VII.

### ANEURISM OF THE PRIMITIVE ILIAC ARTERY.

To pronounce positively on the existence of an aneurism of the **Primitive Iliac Artery** is in the present state of our knowledge scarcely possible. The existence, however, of a pulsating tumor within the abdominal walls between Poupart's ligament and the umbilicus, with the presence of the aneurismal thrill, will furnish very plausible grounds for such a conclusion. It is not designed by the above remark to convey the impression that the difficulty consists in diagnosing the nature of the tumor, but rather to express the impossibility of accurately referring it to the particular artery involved.

**Treatment.**—It is doubtful, from the result of the five cases on record, whether it is justifiable to attempt the ligature of the abdominal aorta for the cure of this formidable disease, inasmuch as it amounts in all probability to an abridgment of life; and while it is true the fatal event must in the natural progress of the disease rapidly occur, yet the right of the surgeon to precipitate it, a single day, by the almost hopeless alternative of an operation, cannot be acknowledged. (See vol. ii.)

## SECTION VIII.

### ANEURISM OF THE INTERNAL ILIAC ARTERY AND ITS BRANCHES.

The existence of an aneurism involving the **Internal Iliac Artery** must necessarily be obscure. When one of its terminal branches is implicated, as the gluteal, ischiatic, or pudic, and the tumor develops itself in the gluteal region, the diagnosis will be less difficult, but not unattended with embarrassment. Aside from the existence of pulsation and thrill, we may expect to have the size of the tumor sensibly diminished by pressure well directed upon the abdominal artery. In persons somewhat emaciated, or where the abdominal parietes are strongly retracted, the aorta is very accessible to pressure immediately to the left of the umbilicus, and when forced against the vertebral column an almost complete command of the lower circulation may be obtained.

**Treatment.**—Should the trunk of the internal iliac be involved close to its root, a ligature should be placed upon the primitive iliac. If, however, the vessel be sound some distance between its origin and the tumor, the ligature should be applied to the internal iliac on the cardiac side of the tumor. In cases where some one of the branches is the seat of the disease, the parent vessel may be tied within the pelvis, or the aneurism uncovered by a careful dissection down upon the gluteal region, and the vessel secured on each side of the sac. (See vol. ii.)

## SECTION IX.

### ANEURISM OF THE EXTERNAL ILIAC ARTERY.

**Symptoms.**—The signs of aneurism of the **External Iliac Artery** are less equivocal than those in the cases just considered. The vessel is one of considerable length, and has no branches distributed until it is about to merge in the femoral; it moreover receives but little support from the surrounding parts, and hence when once attacked the tumor increases rapidly. The occurrence of this aneurism is comparatively rare, though more common in the external than in that of the internal iliac. The pulsation and the physical evidences of aneurism, such as the bellows murmur and thrill, will be ordinarily detected; the movement and sensibility of the leg will be interfered with by pressure on the psoas muscle and crural nerve, and, as the tumor augments in size, the limb will become swollen and edematous, in consequence of the iliac vein being subjected to pressure.

**Treatment.**—As soon as a diagnosis is clearly established, a ligature should be placed about the iliac artery on the cardiac side of the sac. The reported cases of this operation furnish us with a very favorable result. (See vol. ii.)

## SECTION X.

### ANEURISM OF THE FEMORAL ARTERY.

**Femoral Aneurism** may be seen at all points in the femoral artery, but occurs most frequently high up in the groin, because, as the artery is more superficial in this situation, it is more liable to injuries from wounds, etc. The wounds that give rise to femoral aneurism not unfrequently are caused by the practice of carrying in the pocket such a weapon as a pistol, which, exploding accidentally, creates a wound that sometimes results in femoral aneurism. In some cases, this weapon has been made to explode by leaning over the table in playing billiards.

**Symptoms.**—The symptoms of femoral aneurism are those of aneurism generally : thus, a tumor forms; its pulsations are felt; and the patient complains, as the tumor enlarges, of neuralgic pain due to the pressure upon the nerves; the limb becomes swollen from the venous circulation being retarded by pressure, and, when the artery above the tumor is compressed, it will be diminished in bulk and the ordinary aneurismal sounds disappear.

**Diagnosis.**—As the femoral region is the seat of several morbid growths, some care is requisite to avoid being misled, although generally no great difficulty will be experienced in arriving at a satisfactory conclusion as to the existence of aneurism. The diseases from which ordinarily we may be called to distinguish aneurism will be a psoas abscess—as this is frequently conducted by the pelvic fascia beneath Poupart's ligament—and enlargement of the inguinal lymphatic glands. A careful inquiry into the early history of the case will serve to distinguish an aneurism from the abscess. In the latter there will have been an antecedent train of symptoms long before the tumor appeared on the thigh, such as pain in the back, uneasiness in extending the thigh, and irritative fever. The swelling will be found to be soft and fluctuating, and does not communicate any pulsatile movement.

The lymphatic glands, when enlarged, may be recognized by the irregular outline of the tumor, which may be readily distinguished by the fingers.

Treatment.—The treatment of femoral aneurism is most judiciously carried out by means of pressure where it can be effected—this being made upon the external iliac artery within Poupart's ligament, by means of Signorini's tourniquet; or by digital compression maintained through relays of well instructed assistants. When this fails, the femoral artery should be tied, (see vol. ii.;) or if this is not practicable, in consequence of the disease being close to Poupart's ligament, the external iliac should be ligated. But on account of the difficulty of making pressure on the artery without also obstructing the vein, this treatment is not as well adapted to aneurismal tumors high up in the groin, as it has been to popliteal tumors. It should, however, be tried, and if it fails, resort can then be had to the ligation of the external or even of the primitive iliac, although success is to be hoped from the former operation much more than from the latter.

## SECTION XI.

### POPLITEAL ANEURISM.

Popliteal Aneurism, as its name indicates, is one of the external aneurisms which is situated in the popliteal artery, just behind the knee-joint.

Symptoms.—Popliteal aneurism, as a general rule, first attracts the attention of the patient by causing a numbing sensation, or sometimes a sharp, cutting pain in the limb, at the same time that complaint is made of a peculiar feeling in the part, as if something had snapped or given way. Soon after, a very violent pain is felt, running down along the leg, which is sometimes accompanied with cramp and spasms in the calf of the leg as well as the muscles supplied by the posterior femoral nerves. Then a tumor gradually makes its appearance, and enlarges with more or less rapidity, presenting pulsation and all the various characters of the aneurismal tumor before described. As this tumor enlarges, a disposition on the part of the patient to flex the limb becomes apparent, because, when the limb is extended, the pressure of the tendons of the part produces a pain which is relieved when these tendons are relaxed. As a general rule, the tumor shows a disposition to extend rather to the outer than to the inner side of the limb ; and it does this because the greater prominence of the head of the tibia on the inner side of the limb interferes with its development in that direction. This fact should be borne in mind, lest the surgeon, seeing the tumor protruding rather to the outer side than in the median line, should suppose the aneurism to exist rather in one of the branches of the popliteal artery—such as the peroneal—than in the popliteal itself, which is much more generally the seat of the disease. The tumor thus formed and situated may attain the size of a hen's egg, or even larger, and pursue, if left to itself, the same course as aneurisms elsewhere.

Treatment.—The most judicious treatment in the case of popliteal aneurism is compression ; the ligation of the femoral artery in popliteal aneurism being a desirable operation only when compression has been fairly tried. The mode of making this compression, particularly recommended by Bellingham, of Dublin, is as follows : Prepare two clamps like that shown in Fig. 377, and apply one on the femoral artery, near the groin, and the other on the same vessel, in the middle third of the thigh, applying the pressure of one while the other is slack, and loosening the first, but tightening the second, when the first pressure causes the patient to complain. In

applying this pressure, too much caution cannot be used, to prevent its becoming intolerable; and it should always be recollected—as essential to success—that it should be very gently made, so as to diminish, and yet not interrupt the circulation through the artery, and unless compression is made very lightly and gradually, it will cause such pain that the patient will not be able to sustain it. The time required will vary from eight days to several weeks, the secret of success being found in the slowness of the compression, which it is again stated cannot be too gradually or lightly applied. The treatment by ligature will be described in vol. ii. under the ligature of the femoral artery.

## SECTION XII.

### ANEURISMAL VARIX.

**Aneurismal Varix** is produced by a wound of an artery through the vein which establishes a direct communication between the two vessels. The injury is very frequently a result of careless venesection in the bend of the arm. As a consequence of this wound the vein is observed to be filled with arterial blood, distended, tortuous, and varicose.

**Diagnosis.**—The history of the case will be a valuable aid in forming a diagnosis. If the tumor has occurred soon after bleeding, such an affection may justly be suspected.

**Treatment.**—The treatment most likely to afford relief is compression both above and below, as well as over the tumor, applied either by Bellingham's clamps or by some similar instrument prepared for the case.

## SECTION XIII.

### VARICOSE ANEURISM.

Another form of aneurism of the extremities is that which is designated as **Varicose Aneurism**, which is a false aneurism that is formed between

Fig. 380.



A VARICOSE ANEURISM, SHOWING THE ANEURISMAL SAC BETWEEN THE ARTERY AND THE VEIN.—*a*. The artery. *b*. The vein. *c*. The aneurismal sac. (After Sir Chas. Bell.)

the artery and the vein, and opens into both, the sac being formed by the the cellular tissue between the artery and the vein. Both these forms of aneurism are to be treated upon the same general principles already described. They are chiefly liable to occur in the same position, especially in the bend of the arm.

## SECTION XIV.

### ANEURISM OF BONES.

There is another form of aneurism termed **Aneurism in the Bones,** the nutritious artery becoming the seat of an aneurism which produces absorption of the cancellated structure of the bone, and finally a tumor, which has, to a certain extent, the characters of aneurism elsewhere, as has been described under the head of Bony Tumor and Osteo-Aneurism.

**Treatment.**—The treatment is that of aneurism elsewhere, as compression, or the ligation of the vessel concerned, and the employment of such means for the caries, etc. that supervene, as may be demanded; but the result is very uncertain.

## SECTION XV.

### VARICOSE VEINS.

Another complaint of the extremities which requires special attention from the surgeon is that designated as **Varicose Veins,** a disease which, from its frequency, from the inconveniences resulting from it, and from the dangers attending the operations recommended in its treatment, demands careful study.

The term **Varices,** or **Varicose Veins,** derives its origin from the Latin verb *variare,* to turn, and indicates the tortuous and twisted condition into which the enlarged veins are thrown.   The veins affected are generally understood to be those of the extremities, the disease, when existing elsewhere, being spoken of under some special designation.   Thus, when the veins of the rectum are enlarged, it is known as **Hemorrhoids**, or piles; when the veins of the scrotum are affected, it is called **Varicocele;** while the term **Varices** is most generally limited to the form which is found in the external veins of the lower extremities.

**Etiology.**—Varices are generally due to some obstruction in the course of the veins, such as the pressure exercised upon the iliac vessels by the gravid uterus during pregnancy, or certain other tumors, as enlargement of the liver or spleen, tumors within the abdomen, impacted feces in the rectum, etc., or that created on the saphena or femoral veins by hernia.   It has also been caused in the upper extremities by the pressure of the edge of a desk upon the forearm of a patient, and I have seen a well-marked case of it in the upper extremity which was due to this cause, in the person of the editor of a newspaper.

As the superficial and the deep-seated veins inosculate freely, they both usually participate simultaneously in the complaint, though the external are the most evident; and this should be particularly remembered, as it will serve to show the ultimate inefficiency of certain operations which have been highly recommended for the cure of this disorder.

**Symptoms.**—After the disease has existed for some time, it begins to exert an influence over the whole system, but is first shown in a disturbed local circulation, the veins of the part carrying the blood sluggishly to the heart, owing to the continuance of the obstruction which has produced the disease, while, as the arteries of the limb continue to supply it as freely as ever, an effusion of the more liquid portions of the blood takes place into the superficial cellular tissue, from which swelling and thickening of the whole

limb result. Meantime, distention renders the coats of the vein itself, and often the skin immediately covering it, thinner and thinner, until at last it bursts, and a troublesome hemorrhage is the result, or ulceration may be established, and the condition formerly described as varicose ulcer produced.

With regard to the general symptoms, they are often well marked. Thus, the patient first experiencing a tingling or itching in the skin of the limb, which is followed by an irritation that often shows itself in the form of eczema rubrum, many cases of this latter disorder being due to the irritation of varicose veins, and to the interference of the distended veins with the capillary circulation of the affected limb; he also is often troubled with a sense of weight and fullness. When the limb is examined, a change will be at once noticed by the surgeon in the appearance and course of the veins;

and as these vessels have become tortuous and knotted, they can be felt beneath the skin, giving to the fingers very much the sensation of a bundle of worms in a bag; besides which, their tortuous and knotted appearance can be readily discerned by the sight, Fig. 381. The limb itself is also swollen and thickened, and gives evidences of effusion beneath the skin.

**Pathology.**— The morbid enlargement or dilatation of any of the veins of the body has long been regarded as constituting a varix, and to relieve this, surgeons have suggested various operations. The failure of many of these plans to effect a cure, as well as the serious loss of life that has in some instances ensued upon their performance, should induce a close examination of the anatomical relations of these vessels, as well as the pathological changes noted in them. I can, however, now only make a brief reference to the peculiar structure of the coats of these veins, without entering upon their surgical anatomy.

The veins of the extremities, in which the varicose condition is most often seen, are, like the arteries, composed of three coats—a cellular, muscular, and serous or arachnoid one; these coats being generally much thinner in these vessels than in the arteries, the tenuity of the veins being so great as to permit

Fig. 381.



A view of the Position and Tortuous Character of Varicose Veins on the inner side of the Left Leg.

the circulation of the blood to be distinctly seen through them, in consequence of which they are more liable to expansion or rupture upon the application of force. All the superficial veins of the extremities communicate with the deep-seated veins by numerous anastomoses.

In an elaborate paper upon the Pathology of Varices, by Dr. Jno. Watson, of New York,* may be found many excellent observations connected

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* Am. Journ. of Med. Sciences, vol. v. N. S. p. 36.

with their condition.  Speaking of the stages in the progress of varices, Watson refers to the first as being characterized by a simple dilatation of the vessel, which leads to interstitial development or hypertrophy; the second, by an increase in their length, which leads to the formation of folds and serpentine convolutions, these being most common where the vessel is under least restraint; the third, by an increase in the thickness of their elastic or muscular coat; and the last, by a change in the inner coat, which becomes so thickened as to resemble delicate muscular tissue.

Varicose veins may, under favorable circumstances, contract upon themselves, and diminish in calibre, so as to contain less blood than is natural to them.  Or the inner membrane may inflame, throw out coagulated lymph, and thus close its channel; or it may run on to suppuration, as in suppurative phlebitis; or the disease may terminate in death by loss of blood.

Operations upon the veins, by inducing inflammation, may cause death from phlebitis; or the recession of the blood from the varicose vessels into the course of the general circulation, in persons of a plethoric habit, may induce pleurisy and pneumonia; while, under the most favorable circumstances, the most that can be obtained is a temporary relief, the return of the circulation through the anastomosis, between the deep and superficial vessels, often redeveloping similar evils to those which it had been attempted to relieve.  From considerable observation of many of the plans of operating heretofore recommended, I am induced to think that the patient's life is often exposed without obtaining any permanent good, and I shall therefore omit all mention of the operative proceedings usually described as applicable to this complaint.  Those desirous of full information on these plans are referred to the excellent and extended paper of Watson, of New York, to whom I am indebted for much additional information, and to a confirmation of views obtained in Paris in 1840.*  Coinciding in the correctness of his opinions as to the danger resulting from incisions, and similar means of treatment, the following plan, as pursued by him, is the only one to which I will refer.

**Prognosis.**—The prognosis is favorable as regards the effects of the complaint upon the health and life of the patient, but unfavorable in respect to the permanent cure; for though the disease may be relieved and rendered supportable, yet I know of no method likely to effect a radical cure, nor have I found that any of the plans of treatment, or even of the severe and dangerous operations which have been devised for the purpose, have ever succeeded in effecting a cure, without a return of the affection at some subsequent period.

If the complaint is left to itself, the chief inconvenience will be the ultimate formation of the varicose ulcer, the principal danger from which will be the hemorrhage to which it may give rise.

**Treatment.**—The chief indications in the palliative treatment are: 1. To support the coats of the veins.    2. To check the disposition toward hemorrhage.

The palliative treatment consists in the use of cold bathing, with a view of diminishing the activity of the circulation; in frictions of such substances as are likely to modify the effusion of lymph into the cellular tissue; such, for example, as mild mercurial ointment rubbed upon the limb, or advantage may be derived from the use of iodine ointment or of the tincture of iodine painted upon the part, etc.; while such lotions may be employed as will harden the skin, and enable it in the end to act the part of a bandage.

Advantage may possibly be derived in certain cases from an imitation of

the practice of certain of the veterinary surgeons in the cases of "bog spavin" in the horse, in which a hot iron is applied in several places so as to sear the skin, in order that the contraction of the cicatrices consequent upon the operation may so contract the tissue as to cause it to exercise pressure upon the distended veins.

But perhaps the safest and most efficient way of treating varicose veins, and a method which does quite as much permanent good as the many painful and dangerous operations recommended in this complaint, is the application of equal and judicious pressure by means of bandages, laced stockings, gaiters, and similar appliances. Of these, the best contrivance is the elastic stocking, which consists of a stocking properly shaped, and formed by the interweaving of silk with the fibres of caoutchouc. This stocking should be rather tight than otherwise at first, as, after it has been worn for some time, it is apt gradually to become too loose to answer a good purpose. If, however, the expense or difficulty of obtaining this article should be an objection, a very excellent substitute may be made of brown holland by any seamstress; but a buckskin tongue should be placed under the lacing to prevent the cord which laces it up from welting the skin, a very important point in the result, as, in a bad case of varicose veins, the most trifling welting may lead to ulceration, hemorrhage, etc.

**Treatment of Varicose Veins**, by John Watson, of New York.*—The patient having the limb bandaged, and having been kept in bed for twenty-four hours, several small pieces of a common wax bougie should be applied over the course of the varices, some being placed longitudinally and others transversely along the veins, and secured in their position by a roller. Over this apply the starch bandage, and allow it to remain undisturbed as long as it causes no inconvenience, and does not become deranged.

With this simple plan as much may be accomplished as by any other method yet devised, though it will not effect a cure, the patient being obliged to continue the use of his elastic or laced stocking for years, perhaps for life. On account of the length of time which the disease as thus treated lasts, and on account of the expense of the apparatus necessary to carry on the treatment, surgeons at different periods have recommended various operations.

**Radical Cure.**—The *ligature*, whether applied by passing a pin beneath the vessel, and casting a figure of 8 ligature about it, or by subcutaneous application, is a dangerous procedure. The employment of the silver thread subcutaneously, which has been used several times in the Philadelphia Hospital, by Dr. Levis, is thought to have advantages from the metallic nature of the ligature, but a much more extended use is necessary to determine whether the risk of phlebitis is diminished by its employment. *Caustics* are occasionally resorted to for the obliteration of varices, such as the caustic potassa, or the Vienna paste, applied at several points over the principal trunks, and prevented from spreading by cutting small openings in pieces of adhesive plaster, the size required for the caustic, and applying these over the veins. After a sufficient destruction of tissue has been effected, which will require but fifteen to twenty minutes, the progress of the caustic should be arrested by applying acetic acid. This plan, which is probably the least objectionable of all others, is not unattended with danger, from erysipelas or purulent infection; and I must enter my protest against the performance of any of those operations which incise the veins, and can conceive of no case so severe as to justify the risk incurred, and my objection to them is still further increased by the fact that they can rarely or ever accomplish more than a temporary relief, owing to the free anastomosis between the deep and the superficial veins.

Such an anastomosis may be readily proved by injecting the veins after death, and any one who wishes to test the value of the so-called radical cures of varicose veins can easily do so on the dead body by tying the saphena major both at the knee and in the middle of the calf, and then injecting a vein in the foot with a fine injection, when he will find the superfices of the limb finely mapped out with the injecting material that has run in all directions around the ligated veins.

END OF VOL. I.

# INDEX TO VOL. I.